THE

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THE

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1900

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GERMAN INDUSTRIAL FINANCE.

THERE is, we believe, a very prevalent idea among engineers and others interested in industrial enterprises in this country, that one of the most important elements of the present successful commercial rivalry which Germany is offering Great Britain, in such a large proportion of the world's markets, is due to the superiority of the facilities afforded by banks and capitalists generally, to the manufacturing industries in that country. Like most prevalent ideas with reference to foreign countries and unfamiliar commercial enterprises, the one alluded to above rests on a very slender substratum of truth travestied in a garb of fanciful details, which is more or less imaginary. The question is, however, of such importance in this case that we have felt constrained to inquiry carefully into the facts, and give our readers the benefit of our inquiry.

The most useful way of conveying the merits and demerits of the German system will be, we apprehend, to contrast it with the one with which we are most familiar, viz., our own. The first and most far-reaching difference depends on the different limits as to the value of shares and the subscribed capital which the company laws and the commercial customs of the respective countries prescribe. With us, £1 shares and any desired amount of capital, however small, are not only allowable and legal, but are freely sanctioned by commercial usage; in Germany, on the contrary, the lowest value for shares is £50, and for subscribed capital is £50,000. It will be seen at once that in Germany the class of investors to be appealed to differs entirely from that open to company promoters in Great Britain, and necessarily a more select and restricted class, or, in other words, a more moneyed class has to be depended upon in the former than in the latter country. The British system, with its thoroughly democratic limits of share values and subscribed capital, would be much preferred in German promoting circles to their own system, and efforts are being made with a view to altering their company laws in the direction of our own. Should these prove successful a boom in new industrial and other companies is confidently anticipated. So far, therefore, the German system as contrasted with the British is obviously more cramped and confined, but, at the same time, safer and more assured. The obtaining of capital, especially for small undertakings, through the ordinary channels open to British companies, *i.e.*, an appeal to the subscribing public, is to a great extent closed. Yet undertakings requiring small capital do undoubtedly obtain the capital they require in Germany as well as in Great Britain, and with probably more certainty and less difficulty.

How is this managed? In Germany, as in England, there are firms and syndicates who control ample capital and devote themselves to the work of company promoting; but while in Germany they are forced to find a large proportion of the capital required from their own resources, *i.e.*, are compelled to treat the small enterprises financed by them largely in the light of investments, in this country the facility and temptation afforded by an issue of £1 shares to a confiding public is generally too great for these firms and syndicates to resist, and their capital is invested in more extended promotion operations rather than in the practical working out of any of the undertakings promoted.

We now come to the chief advantageous feature presented by German as contrasted with British financial conditions as affecting their industrial enterprises. In Germany most of the leading banks have what might aptly be called an

industrial side, and there are also not a few purely industrial banks. In the case of the former a certain proportion of their capital is specially subscribed and held at the directors' disposal for the purpose of taking up and floating industrial concerns, while, of course, in the case of the latter nearly the whole of the subscribed capital is devoted to this same object. The great advantage of the existence of this branch of banking business to industries lies in the conditions necessarily arising therefrom. When money is available and specially held for the purpose of being employed in a certain line of business, this is stimulated and enlivened thereby; and when industrial enterprises do not spontaneously offer themselves to be financed, they are looked for, and in many cases the germ of an industrial undertaking may be the inquiry which set people thinking upon a possible improvement in, or derivative of, a manufacturing process. In the second place, in the hands of banks the viscissitudes to which ordinary company promotion is so largely and disastrously liable are generally absent, for the banks have not only abundant capital of their own to invest, but they have their regular clients with whom to place the remainder they do not themselves desire to hold, and a Stock Exchange quotation follows as a matter of course immediately on flotation and the issue of shares, which is by no means the case here. Vendors, although they cannot expect to command the inflated paper prices, which they obtain on this side, nor the proportion in actual cash, find no difficulty in realising the paper which they do receive as the shares have an immediate market value. Practically the only parallel to the limited liability company, as we understand it, existing in Germany, is the private syndicates or associations which are often formed in a voluntary way for the purposes of promotion between people interested in industrial and commercial undertakings, and in which the general public has no part or interest.

On the whole, the beneficial modifications which might be borrowed from German practice and grafted on our own are practically limited to those regulating the mutual relations between our banks and industrial undertakings—either by the introduction of purely industrial banks or the allocation of portions of the ordinary bank funds for investment in industrial concerns and their promotion. The freedom of our system of democratic subscription of capital, with its broad basis of popular support, would be very disadvantageously exchanged for the narrower, if sometimes safer backing, of capitalists powerful enough to become financial monopolists, the undesirable character of whose influence, in the case of nascent Colonial enterprises, has been so powerfully animadverted upon quite recently by Herr Eugen Wolff with reference to the Northern Cameroons.

O Tempora! O Mores!

In the profession of Civil Engineering professional etiquette is closely adhered to, because the industry is one which has been carried out on formal lines for the last hundred years. In the course of the training of young men as civil engineers they come into contact with an established practice, and from the moment they enter their offices in Westminster they are imbued with the best traditions of the profession. Doubtless in course of time our electrical industry will have sufficiently aged to provide a similar training for the young men entering its ranks. At the present time, however, the juvenility of the industry is such that the training of the young men is of a very heterogeneous character, and the opportunity of joining engineers of years' standing is only just being afforded to them. It is therefore not surprising that there are a number of young gentlemen in the profession to whom the tenets of professional etiquette are absolutely unknown, with the result that they indulge in modes of procedure which the members of the older branches of the profession would view with horror. For instance, we actually know of a case that has occurred this month where a sub-committee of a municipality, after inviting terms from a limited number of consulting engineers, made a unanimous choice. They fixed upon one who, in the opinion of the leaders of the profession, would most worthily have fulfilled the trust reposed in him, and would most efficiently have executed the work. Between the time of the unanimous choice of the sub-committee and the presentation of their report to the full committee, two among the disappointed candidates engaged a commercial traveller in the district to throw mud at the engineer chosen by the sub-committee, and another of them actually had the effrontery to remind a manufacturer in the district of former orders, with the object of showing him that there would be no encouragement in future for them to recommend his material, unless he withdrew his support of the engineer chosen. In taking such a step as this, the disappointed engineer betrayed a notion of his functions which made it obvious that he was quite unfit for the post of consulting engineer. The engineer who best fulfils the trust reposed in him by his clients is one who does his duty without fear or favour, and if, in the execution of that duty, he has to allot a contract to his deadliest enemy, he should do so without the slightest compunction.

Electrolytic Corrosion of Water-pipes.

It is to be expected on theoretical grounds that leakage currents from electric railways will have a corrosive action on underground pipes, and more than one investigator in the United States, the land *par excellence* of the electric railway, has shown that serious corrosion does actually take place. A common device adopted to abate the nuisance is to connect the pipes near the central station to the negative bus bar, but that this is an altogether inadequate remedy is shown in a remarkable manner by some recent investigations carried out by Prof. Lucien Blake at Kansas City, U.S.A. Prof. Blake has made numerous measurements of the resistance of cast-iron water mains, and he finds that the greater part of their resistance, which is by no means small, is concentrated at the joints. In several cases examined, he found that the resistance of the joints formed from 80 to 96 per cent. of the whole resistance of the line of pipes. This fact has a most important bearing on the question of electrolytic corrosion. Bonding the pipes to the negative bus bar increases the current in the pipes, and though it reduces the outflow of current from the pipes near the power station, it increases the shunt currents which must necessarily pass round joints of high resistance. Hence the corrosion near the joints of the pipes is increased in proportion to its decrease in the danger area near the station. Prof. Blake says :—

> **Electrolytic pittings were found on many sections near the joints, only on the positive side, where the current was shunted around the joints. Some of the pittings were ½ inch deep. The interior of the pipe could not be examined. Again, a length of 6-inch cast-iron main was taken up in another part of the city, and internal electrolytic effects were apparent near the joint. A chemical analysis of the material dug from pits gave 22·3 per cent. graphite, 49·7 per cent. iron. A second length was removed and broken into, and a fresh fracture revealed *internal* electrolysis by the discolouration of the iron where the pitting was taking place, and which was already ¼ inch deep, beginning from the inside. A number of similar cases were discovered, and are convincing proofs that cast-iron mains cannot convey currents without electrolytic damage, when these mains form part of the return circuits of electric railways.**

It appears also that coating the pipes with asphaltum does not protect them from corrosion. Under the asphaltum, which remains bright and apparently intact, pittings were found, and a fresh fracture or a careful scraping away of the coating revealed spots of graphitic structure, left by the electrolytic action on cast-iron. These and other investigations are making it more evident that it will be necessary to keep the leakage currents out of underground pipes; and this, of course, means that return currents from the rails must not be allowed to enter the ground except in amount so small as to be harmless. This cannot be effected by the most perfect system of bonding the rails. The only feasible plan at present known appears to be the employment of insulated return feeders. The exhaustive investigation of the mathematics of return feeders, by Bohm-Raffay, which we recently published in the Electrical Review, shows that the number and cost of these return feeders are not by any means prohibitive. He shows that a comparatively small number of return feeders will bring about a very large reduction in the potential difference between the rails and the ground, and as the insulation required is very small, its cost will be small, and all the cables may be safely laid in a single conduit.

APPARATUS FOR USE IN EXPERIMENTAL FUSED ELECTROLYSIS.

By ALEC. A. BEADLE.

(*Concluded from page* 84.)

If a small special furnace is required for moderate temperatures in a great hurry, it can be cast roughly in Portland cement (with a little silver sand), and can be bored and shaped before it is allowed to properly set. It should then be bound round with stiff iron wire and dried gently, after which it will stand heat, if carefully applied, better than would be supposed. For very small preliminary experiments in porcelain crucibles, it is often best to simply place the crucible in a retort stand, with a sheet of asbestos cloth round it, hold the electrodes in clamps above it, and heat by means of a clear Bunsen burner placed beneath.

With regard to crucibles, it is essential, first, that they should not crack or break when heated with a heavy weight of salt or metal inside, and secondly, that they should not be too porous, so that the salts leak through and get into the furnace.

There are many kinds of clay crucibles. For very small experiments porcelain ones should be used, and the author recommends the use of good thin ones, as they can be used several times, whereas the cheaper ones often stand only once. For larger experiments, "Battersea round clay" stand fairly well, also those made for melting iron in, and "Battersea fluxing pots" are very fairly non-porous, and of a very convenient shape. Crucibles for gold melting are expensive, but for small experimental work, where a strong non-porous clean crucible is required, they are invaluable. Black plumbago crucibles are most useful where the crucible itself is required to be made the cathode. A small hole cut into the edge, and filled with lead, into which is placed a clean copper or iron wire, serves as a connection; or iron wire may be bound tightly round the crucible, and covered with asbestos paper, or the wire may be screwed with a bold thread, and tapped into the bottom of the crucible. Pure carbon crucibles can be quickly made to order by Le Carbone, 36, Lime Street, E.C.

The caustic alkalies may be melted in iron crucibles, cast-iron being the most suitable. They are not, however, made in many sizes, and the stamped ones are too thin to be of much service.

If it is required to make a long-continued experiment in a clay crucible, it is a very good plan to put it into a cast-iron case, just made to fit, filling in between with one of the cements described later.

Since there is some difficulty in boring holes in the bottoms of crucibles for the introduction of electrodes, &c., if many are likely to be required, it is as well to have them specially made. Fig. 10 shows a very useful form, in which any

Fig. 10.

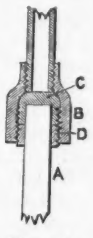


Fig. 11.

luting placed in the bottom will be firmly held; it may be enclosed in an iron case (I) as shown. Earthenware jampots and salt-jars placed in well fitting iron cases, sand being placed between, make admirable crucibles, and will stand a dull red heat perfectly for a long time.

Now, with regard to cements and lutings, there are many, but few need be mentioned.

Ordinary Portland cement, made with a fairly strong solution of sodium silicate, makes a strong cement for luting electrodes into the bottoms of crucibles, and is not very porous. Fireclay and silicate, plaster of Paris and silicate, all serve a similar purpose. A sort of putty, which will keep soft for weeks, can be made by mixing a strong solution of silicate with either powdered asbestos or powdered mica; this can be used for luting gas-tight joints, &c., but should be very carefully dried by heat, as in drying it is apt to blow bubbles, and become very porous.

When the electrodes are metallic, no difficulty is experienced in making connection on to them, but when they are of carbon it is not so easy. If the carbons can be made long and the ends brought well out of the furnace, ordinary clamp connections may be used; if the connections have to be made in a hot place, fig. 11 shows a very simple method of making them. A is the carbon to which connection is to be made, B is an ordinary gas barrel reducing socket into which the carbon is placed, cement is pushed in at D and molten lead run in at C. Connection is then made to the main circuit at the upper and cooler end of the iron tube.

The lids for crucibles may be made of thick asbestos millboard, mica sheet or thin firebrick tiles, which are made in several sizes, and easily procured from laboratory furnishers. These, with the help of retort stands, may be made to support the electrodes.

The material of which the electrodes should be made depends, of course, upon the work that they are required to do. For cathodes, iron stands well in the fused alkali chlorides, for the electrolysis of caustic alkali or of lead chloride; carbon stands for that of lead chloride or zinc chloride, but is not recommended, as a spongy deposit is the result. Iron cannot be used for zinc, as it alloys rapidly with it. The metals which it is desired to deposit are often best, thus lead for lead, zinc for zinc, cadmium for cadmium, &c. As a cathode, copper acts similarly to iron. As an anode, carbon stands perfectly in the alkali chlorides, and iron in the caustic alkalis. Nothing seems to be able to withstand fused nitrates.

Porous partitions, bells for collecting floating alkali metals, &c., are very difficult to construct satisfactorily. Chlorides slowly dissolve and disintegrate fireclays; alkali metals act upon them, chlorine or other hot halogens rapidly corrode metals, even when perfectly dry. Compressed magnesia or quick lime may sometimes be brought in for use as a porous partition. So little apparatus is at our disposal for such work, that it is found that domestic utensils of all kinds may be brought in to serve some useful purpose. Enamelled cast-iron pails and enamelled wrought-iron ware of various kinds are all useful as crucibles. Saucepans, garden flower-pots (for porous pots), &c., may be made useful, and, in fact, it is well to have a good mental catalogue of everything in commerce which is capable of serving a useful purpose.

Not every experimenter has gas laid on in sufficient quantity to supply furnaces, even if he has it at all, and it is therefore important to look round at the various forms of hydro-carbon burners which can be easily and safely used to supply the necessary heat.

The well-known Swedish paraffin blow lamps, made by Messrs. B. A. Hjorth & Co., Stockholm (London agents, Messrs. Moeller & Condrup, 78, Fore Street, E.C.), are most useful and efficient in this respect. Their "two-pint inclined Aetna" is the best all-round, and is illustrated in fig. 12,

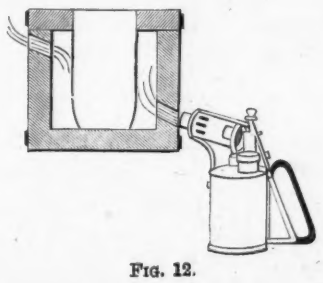


Fig. 12.

being shown blowing into one of Fletcher's round furnaces adapted to the circumstances. These burners are very powerful, and perfectly safe. Their heating power can only be determined by experience, but one is roughly capable of fusing ½ pint of salt in about 40 minutes. They can be used with almost any kind of furnace; the author has, by means of two, heated a muffle 6½ inches × 4½ inches × 3½

inches to cupelling temperature in half-an-hour. Two will melt about 3 lbs. of copper in one hour. For larger work or higher temperatures "Nelson's automatic benzoline furnace" will be found most useful.

It will be noticed that in the furnace shown in fig. 9, a furnace door is provided to put in the place of the burner when the latter is removed, so as to prevent draughts of cool air blowing in and cooling the crucible when the burner is removed. This is because the current, when once started, is often sufficient to keep up the supply of heat for the furnace, a method of heating which, on a large scale, will probably prove economical. In small laboratory experiments, each pound of salt in the crucible requires from 100 to 300 watts to maintain it at a red heat.

[Erratum.—Electrical Review, January 19th, p. 83. Figs. 2 and 3 were wrongly placed and numbered. That marked fig. 2 should be fig. 3, and *vice versâ*.]

ON FRICTION LOSSES IN DYNAMOS.

By ALFRED HAY, B.Sc., M.I.E.E.

A considerable amount of uncertainty and misapprehension still appears to exist among many electrical engineers as to the laws which govern the mechanical friction losses occurring in dynamos. One or two examples of the confused state of knowledge on this subject may serve by way of illustration.

To take an instance which is now several years old, we find Mr. W. B. Esson, in his classical paper on "Some Points in Dynamo and Motor Design," * referring to the magnetic pull on the armature of a single-magnetic circuit dynamo, and stating that this pull leads to excessive heating on account of the increase in the friction loss *due to increase of pressure on the bearings*.

As, however, it seems hardly fair to criticise a statement made as long as nine years ago, we shall take two more recent instances containing the same fallacious doctrine.

In his admirable treatise on "Continuous Current Dynamos," published last year†, Mr. J. Fischer-Hinnen not only makes the friction loss depend on the pressure on the bearings, but introduces a definite coefficient of friction, and explains how the tension of the belt is to be taken into account in calculating the friction loss.

To come down to a still more recent date, Prof. F. G. Baily, in his interesting article on "The Testing of Hysteresis in Armature Cores,"‡ makes the statement that "for the bearing friction to be constant the load on the bearings must be kept accurately constant."

The above examples will suffice to show how wide-spread is the notion that the friction loss depends directly on the bearing pressure, and that any cause which increases this pressure—such as an increase in the tension of the driving belt, or a slight want of symmetry in the magnetic field—will also increase the friction loss in the same ratio.

In 1883 and 1884 Mr. Beauchamp Tower published the results of an elaborate series of tests on the friction of journals,§ and a glance at the figures obtained by him is sufficient to show that, for a given speed, the *friction loss does not vary appreciably with the load* which the journal has to bear. In other words, assuming that the supply of lubricant is plentiful, there is no such thing as a definite constant coefficient of friction connecting the pressure on the bearing with the tangential resistance to motion.

The friction loss is, in fact, a problem concerning the behaviour of a thin film of viscous liquid. With proper lubrication the journal is completely separated from its bearing by a thin film of the lubricant, and the loss of energy is due to the tangential stresses in the lubricant, and not to abrasion between two solid surfaces. An elaborate theory of lubrication, based on the hydro-dynamical equations for a viscous fluid, was published by Prof. Osborne Reynolds in 1886,* and applied by him to the experimental results obtained by Mr. Tower.

The most recent experiments on friction losses in dynamos are those carried out a few months ago by G. Dettmar.† They go to confirm the results obtained by Tower, and show conclusively that within the limits occurring in practical working, the loss due to friction is, for a constant speed, and with a properly lubricated bearing, *quite independent of the load*. Two further results of interest are established by these experiments, viz, that the power lost by friction increases as the 1·5th power of the speed, and that, between the limits of 15° and 50° C., it varies inversely as the temperature.

It is probable that with the modern forms of self-oiling bearings, in which a plentiful supply of lubricant is always maintained by rings dipping into an oil well and slowly carried round by the shaft, lubrication is much more perfect than it was in the early machines. Difficulties due to heating of the bearings in some of the earlier machines are to be ascribed to imperfect lubrication, or insufficient care in bedding the journals, rather than to the increased pressure due to a want of symmetry in the field.

A very interesting experiment bearing on this point is recorded by Dettmar.‡ A large eight-pole generator was run with its topmost pole not excited so as to produce a very strong downward pull, and the power required to drive it was carefully measured. The topmost pole was then excited, while the lowest pole was left unexcited, so as to relieve the pressure on the bearings. Not the slightest change in the power required to drive the machine could be detected.

It is extremely unlikely that any pull due to a want of symmetry in the field will ever exceed that produced by leaving one of the poles unexcited. Hence, if it is found that the machine runs cool when not excited, but that heating of the bearings takes place as soon as excitation is allowed to take place, then this result must be regarded as due either to bad workmanship or defective lubrication. An increase of pressure on the bearings cannot, by itself, cause increased heating if the journal is properly fitted and lubricated.

* *Journal I.E.E.*, Vol. xix., p. 125, 1890.
† "Continuous Current Dynamos," by J. Fischer-Hinnen. London: Biggs & Co.
‡ The *Electrician*, Vol. xliv., p. 323.
§ *Proc. Inst. Mechanical Engineers.*

* *Phil. Trans.*, 177, pp. 157—234, 1886.
† *Elektrotechnische Zeitschrift*, 20, pp. 380—383, and 397—400.
‡ *Elektrotechnische Zeitschrift*, 20, p. 651.

MUNICIPAL TELEPHONY.

To the *Municipal Journal* of the 19th inst., Mr. A. R. Bennett contributes an article on "Municipal Telephones." He anticipates that within a few days of the appearance of the article Glasgow will have received its license, the delay which has occurred since the passing of the Act being "due chiefly to the inertia inseparable from Government departments." Mr. Bennett gives some particulars of the progress in Guernsey, and recommends local authorities who contemplate taking advantage of the Telegraph Acts, 1899, to send deputations there to test the working and examine the accounts. He thinks that "the threadbare bugbear of the evil of two exchanges in one town need not cause any alarm," because at present "important subscribers are kept so busy that it is often impossible to get connection with them," whereas if connected with two systems, as reduced rates would permit, there would be two channels instead of one. Moreover, the duplicate connections would guard against the interruptions from breakage of wires or other accidents. The privileges of a municipal service are referred to, and "a word of warning" uttered on the subject of underground wayleaves, which are described as the most valuable asset that local authorities possess. The reductions in charges recently made by the National Telephone Company are criticised, and "the new tariff, highly as it has been vaunted," is said to compare "very unfavourably with that in force in Guernsey, and also with that which has been approved by the Tunbridge Wells Town Council for their intended exchange."

The article concludes with the statement that "there is no industry so profitable as telephony. Gold mining is not

worthy of comparison with it, and local authorities who go into the business with circumspection may look forward with confidence to reaping benefits comparable with anything derivable from gas, water, tramways, or electric lighting." We cannot agree with Mr. Bennett that gold mining and municipal telephones are not worthy to be compared. Gold mines are known to be of two kinds—those from which gold is taken out and those into which gold is put. It is very generally believed that the latter are the more numerous. Local authorities who contemplate taking advantage of the Act will, we think, do well to "go into the business" with very considerable circumspection.

Contrary opinions may reasonably be held on the question whether the telephone service is a suitable service for a municipal body to undertake, but there will hardly be a difference of opinion on the question that there should be reasonable evidence either of the profitableness of any work so undertaken, or of its necessity for the general welfare. Any evidence which may exist of the profitable nature of telephone work is, unfortunately, vitiated by the fact that it has not yet been undertaken upon the conditions which will operate when municipalities come into the field. In the necessary absence of proved results, it is inevitable that the expectations of returns must be the subject of estimate—which is generally the case in prospectuses of gold mines. The more sanguine the estimate, the more cautious the wise investor. Still more cautious the trustee who is handling money not his own.

MOTOR-WHEEL FOR VEHICLES.

One of the latest and most original developments of the automobile is a motor wheel, which has recently been patented by Mr. J. W. Walters, of 302-306 W. 53rd Street, New York. The following illustrations and description are taken from the columns of the *Scientific American*.

The new device stands in a class quite by itself, as will be seen from the accompanying engravings, one of which shows the wheel with its motor and steering gear attached to a wagon, and the other the same motor wheel unattached. In a certain sense it may be likened to the steam locomotive; for it is entirely self-contained, and although it cannot run alone, and serves to support a part at least of the load which it draws, yet it bears much the same relation to the wagon, carriage, or other vehicle to which it is fitted as the locomotive does to its train.

The motor wheel consists essentially of a heavy wheel which is journaled in a stout yoke or fork, the head of which turns in a socket. The arrangement is similar to the front wheel and fork of a bicycle except that, instead of being controlled by a handle bar, the wheel is steered by a hand wheel, shaft and gear wheels, as shown in the illustrations.

To the right hand fork is attached a two-cylinder gasoline motor, and two gasoline tanks are carried on the other fork. The wheel is driven through a loosely mounted pinion, which meshes into a gear that is bolted to the spokes of the wheel, and a clutch mechanism, the lever for operating which is within easy reach of the driver of the wagon. The two cylinders are carried horizontally, one on each side of the fork, with the crankshaft, upon which is keyed a fly-wheel, between them. The motor wheel is built in various sizes, from 1 H.P., suitable for a bicycle, up to 4 H.P. for a carriage, or 10 or more H.P. for a heavy dray or truck. In attaching the motor wheel to any existing vehicle, it is merely necessary to remove the framework of the front wheels and bolt the steering socket to the body of the wagon, as shown in fig. 2. When the motor wheel is applied to

Fig. 1.—A Detached Motor-Wheel, Showing the Motor, Fly-Wheel, and Steering Gear.

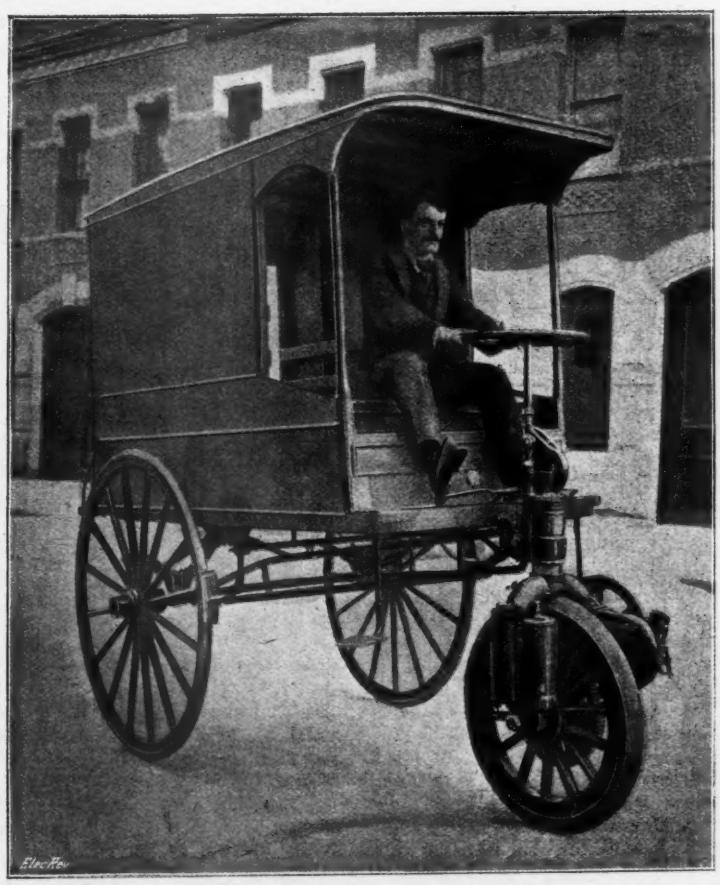


Fig. 2.—The Motor-Wheel at Work.

a light vehicle, it is attached in front, thus transforming the same into a tricycle. In the case of hansom cabs, it is attached at the rear. When it is applied to the heavier vehicles, such as express wagons, coal carts, &c., two idle wheels are attached to the motor wheel and work in unison with it.

One material advantage claimed for this system is that no reversing mechanism is necessary, the motor always running in the forward direction. If it is desired to back the car, the motor wheel is turned completely round in the steering socket and the motor started. It will be noticed that as the motor wheel is entirely self-contained and has a single point of attachment to the car, none of the twisting strains, due to the irregularity of the road, are thrown upon the motor; moreover, in case of disablement of car or motor, the ease with which a change of motor wheels from one car to another can be made conduces to facility and rapidity of repairs.

ELECTRIC METERS.

PROVISIONS with regard to the use, certification, and inspection of electric meters are contained in Secs. 49—59 of the Electric Lighting (Clauses) Act, 1899. In view of the importance of these instruments, both to the supply companies and to consumers, it may be useful to draw attention to the more important rules and regulations which have been made with regard to them.

It is provided in the first place, by Sec. 49, that unless otherwise agreed, the amount of energy supplied by the undertakers to any ordinary consumer, shall be ascertained by means of an appropriate meter duly certified in accordance with the provisions of the special order, *e.g.*, the provisions of the schedule to the Electric Lighting (Clauses) Act, 1899, as modified by any special regulations. A meter is said to be "certified," when certified by an inspector, appointed under the special order to be a correct meter, and to be of some construction and pattern, and to have been fixed and connected in the manner approved by the Board of Trade. Any alteration in a certified meter renders it uncertified unless again examined by an inspector. [Sec. 50.]

The above section might be taken to mean that the Board of Trade will itself undertake the inspection of meters. It is, however, expressly provided in the rules issued by the Board of Trade Electrical Standardising Laboratory (1897), "that meters for the measurement of quantity or energy cannot be received with a view to certification for use in connection with the supply given by undertakers under Electric Lighting Orders."

This does not mean that the consumer has no redress if he thinks that the meter is not registering correctly. On the contrary, it is provided by Sec. 51, that any consumer upon paying the required fee, may employ an inspector to examine any meter, and certify it as a certified meter if it is entitled to be so certified.

Apart from the license mentioned in this section, an inspector, being an officer appointed by the undertakers, may at all reasonable times enter any premises to which electricity is or has been supplied by the undertakers, in order to inspect (*inter alia*) the meters upon those premises. [See 45 & 46 V., c. 56, s. 24.]

By Sec. 52 it is provided that where the value of the supply is to be ascertained by means of a meter, the undertakers must be prepared either to sell or hire a meter to any consumer, and to fix it upon his premises and connect the service lines therewith and procure the meter to be duly certified. They may, however, before supplying the meter, require security for the price thereof to be given by the customer.

It is probable that the provisional order which gives power to the company to hire out meters will contain provisions with regard to the stamping of these instruments.

Sec. 53 provides that no consumer shall connect any meter used, or to be used under a special order, with the service lines, or disconnect any such meter, unless he has given to the undertakers not less than 48 hours' notice. Contravention of this section involves payment of a penalty not exceeding 40s.

A clause similar to this may be found in the Gasworks Clauses Act, 1871, Sec. 15. The offence prescribed by this section must be kept distinct from that class of offences which involves the theft of electrical energy, for which, by virtue of Sec. 23 of the Electric Lighting Act, 1882 (45 and 46 V., c. 56), a consumer may be found guilty of larceny.

In the case of Wood *v.* West Ham Gas Company (52 L.T. 817), the appellants, on their own premises, substituted for part of a gaspipe belonging to the respondents a larger pipe for the purpose of increasing their supply. This was done without any fraud, wash, or misuse of the gas, but without the respondents' consent, although notice of intention to disconnect the pipe from the meter was duly given under Sec. 15 of the Gasworks Clauses Act, 1871. Upon the hearing of the summons a stipendiary magistrate convicted the appellants under Sec. 18. It was decided, upon a case stated, that the appellants had, within the meaning of that section, caused to be laid a pipe to communicate with a pipe belonging to the undertakers without their consent, and that the magistrate rightly convicted them.

The expense of keeping the meter in proper order devolves upon the consumer [Sec. 54]. In default, the undertakers may cut off the supply. It should be noticed, however, that where the undertakers order the inspection of the meter, and it is found to be in proper order, the expenses of making the necessary examination, connections, &c., must be borne by them. Otherwise, it is defrayed by the consumer himself. This section also gives the undertakers the right to inspect the meter at all reasonable times.

Sec. 55 prescribes the terms under which the undertakers may hire out meters for the purpose of ascertaining the value of supply. Should any difference as to terms arise between the parties, the same are to be referred to the Board of Trade for adjudication.

Undertakers must keep meters let for hire in repair, and in default of their doing so the consumer shall not be liable to pay rent for the meters during such time as the default continues [see Sec. 56]. The expenses of procuring such hired meters to be re-certified also falls upon the undertakers.

Sec. 57, which provides for the determination of disputes which may from time to time arise between the undertakers and the consumers as to the accuracy of the amount of electricity registered, is, perhaps, the most important of all. It is there provided that such disputes are to be settled, upon the application of either party, by the inspector, or in cases where the local authority are the undertakers, by an inspector duly appointed by the Board of Trade. The decision of the inspector is final, and he has power to award costs of the hearing to the successful party. The section concludes with the words, "Subject, as aforesaid, the register of the meter shall be conclusive evidence, in the absence of fraud, of the value of the supply."

The register of a *gas* meter is *primâ facie* evidence of the quantity consumed, and two justices are empowered to settle differences. Sec. 20 Gasworks Clauses Act, 1871 (34 and 35 V. c. 41, s. 23). In Gas Light and Coke Company *v.* Cresswell (1897), 61 J. P. 699, it was apparently laid down that where the only evidence of the amount is afforded by the meter, the court will be unwilling to go behind it. The complainant has never challenged the accuracy of the meter by appealing to an independent authority.

With regard to the finality of the decision of a Government inspector, it may be noted that in the case of the Wandsworth and Putney Gas Company *v.* Rye (31 Sol. J. 633) the accuracy of a gas meter sworn to be perfectly accurate by a Government inspector was successfully disputed, not by the production of any expert evidence, but merely by the sworn testimony of the plaintiff and his servants who deposed that less gas had been used in the quarter immediately preceding that for which the company sought to charge.

By Sec. 58 it is provided that where a consumer has been provided with a certified meter, and the undertakers subsequently change their method of charging for energy supplied by them from the main, they shall defray the reasonable cost of his obtaining a new meter. In default, the consumer may recover the amount as a civil debt.

Thus, suppose by virtue of the proviso to that effect contained in the Board of Trade Regulations of 1895, the undertakers altered the standard pressure at which they undertook to furnish the electric current. In such a case the supply of new meters to their consumers would be incumbent upon them.

It is fortunate for the consumer that in the majority of cases he will not have to wait for the errors of his meter to be discovered owing to the appalling magnitude or the surprising insignificance of his electric lighting bill. Thus it is provided in Sec. 59 that the undertakers may place a suitable meter upon any of the premises of their consumers in order to check the measurement of the consumer's meter. Such meter is to be of a construction and pattern prescribed by the Board of Trade.

It will be seen from this section that the checking of a consumer's meter is entirely optional with the undertakers. No doubt if a consumer had suspicions that his meter was not working properly, the company would be prepared to make the necessary investigations at a small cost.

Generally, it might be remarked, that meters, or at any rate gas meters, erected on the premises of consumers at the cost of the consumer, but which remain the property of the company, are among the articles, the value of which should be deducted from the gross estimated rental when the works are being assessed to the poor rate. [R. *v.* Inhabitants of Lee, L.R., 1 Q.B. 241; 35 L.J., M.C. 105.] The rule probably applies to electric meters.

One provision with regard to meters remains to be considered. It is provided by Sec. 25 of the Electric Lighting Act, 1882, that where (*inter alia*) any electric meters belonging to undertakers are placed on premises not being in possession of the undertakers for the purpose of supplying electricity . . . . such meters shall not be subject to distress, or to the landlord's remedy for rent where the same may be, nor be taken in execution under any process of a court of law or equity, or any proceedings in bankruptcy against the person in whose possession the same may be.

THE ELECTRICAL CRISIS IN MARYLEBONE.

The relations between the Metropolitan Electric Supply Company and its consumers in the district of Marylebone have reached a somewhat acute stage; indeed, the view taken by consumers on the inadequate supply has led them to bring their grievances before the President of the Board of Trade, and a report of the interview appeared in our last issue. The complaints were perfectly definite. It was stated that for several years past the pressure had been irregular, and occasionally it had failed altogether. For the past two or three months failures had been of almost daily occurrence, and sometimes they had occurred twice a day. Sometimes the company had given notice of its intention not to supply current during several hours of the afternoon, but in the majority of cases the failures had taken place absolutely without notice. It was shown that in many premises the extinction of the light had resulted in a complete cessation of work, and the dangers that might arise in a commercial establishment owing to failure of light were enlarged upon to a considerable extent; lastly, there was strong complaint as to the prices charged in the district. It was apparently admitted even by the company, that the failures had been both frequent and serious. It is hardly necessary to dwell upon the serious commercial loss that might happen in any district if a failure of the light were to occur, and the consequences that might result in surgical cases are almost too serious to contemplate. Notwithstanding the somewhat flippant manner in which the *Times* treats the subject, it is manifestly absurd to suppose that a company which is so dependent upon the good-will of its consumers as an electric lighting concern, would wilfully indulge in practices that resulted in an extinction of light. There must obviously be, at the bottom of these failures, certain engineering difficulties that have not been properly met, because though one can appreciate the fact that too many consumers on lighting circuits might bring about a poor light, owing to a drop in volts, this would not by any means explain the number of actual extinctions of light lasting in some cases for a considerable period. One hears all kinds of rumours as to the working of machinery in various electric lighting stations, but it would be unwise, if not unfair, to place any reliance upon such statements. It is, however, a somewhat notable fact that since December 15th, the date on which the Metropolitan Company suggested that their troubles would cease on account of the addition of new generating plant, there have been sundry serious stoppages; so it is apparent that the new dynamos have not yet given that immunity from failures which was expected. There may be, of course, a good deal in the statement of the company that the inability to secure Welsh coal has been responsible to some extent for the inefficient lighting that has prevailed in the Marylebone district, but this and other matters suggest one thing very clearly, and that is, the Metropolitan Company has been carrying on its business with too little margin. It is not satisfactory to endeavour to make contractors partially responsible, because the electric lighting company in the management of its business should take such precautions as would have avoided the disasters of the past few weeks. From the Metropolitan Company's point of view, it is most unfortunate that these interruptions in the continuity of light should have taken place, because it is practically playing into the hands of those ardent advocates of municipalisation that abound in the parish of Marylebone, and it is no exaggeration to say that the municipal interests were strongly supported in the recent interview with the President of the Board of Trade.

It is well known that the Marylebone Vestry has long sighed for a municipally controlled electric lighting system. Indeed, this is put forward as the panacea for the ills that lighting customers have borne in Marylebone. But though, as we have said, the company has inadvertently provided its opponents with a strong case, there are one or two matters that should not be lost sight of when considering the means by which the lighting system of Marylebone could be improved. It must be remembered, first of all, that the Metropolitan Electric Lighting Company is the owner of the second largest electric distributing system in the country. It has incurred a capital expenditure of nearly one million pounds, and has an annual output of over seven million units, and it endeavours to supply light to 430,000 8-c.p. lamps spread over a very scattered district. It may be, therefore, that beyond a certain point in the development of an electric lighting system certain difficulties crop up which are never experienced in the early days of a concern, or probably a better way of putting it would be to say that as the area of distribution grows the points of weakness are increased. Such a statement could be reasonably applied to many of the breakdowns that have occurred in different parts of the country. But if there is any truth in this view, municipal systems ought to meet with similar difficulties, and that is precisely what has happened. The interruptions in supply and poorness of light are not confined to electric lighting companies, as recent events in Manchester and Edinburgh have shown. It is not to our minds clearly established that the Marylebone Vestry, if it became a supplier of electricity, would not at some period of its career experience many of the difficulties that are now being encountered by the Metropolitan Company. It is true that it might be enabled to avoid some of the now obvious pitfalls of electricity supply. The Vestry in its pious wish to see that its ratepayers had a good reliable light, might put in at the outset heavy copper feeders that would be adequate for future demands, it might even permit itself the luxury of a large reserve plant, but we doubt it, for these things mean heavy interest charges, and how could this condition be sustained in the face of competition? If the Marylebone Vestry ever be permitted to enter into a commercial rivalry with the Metropolitan, it may be a more serious matter for the ratepayers than is at present realised. The latter would enter the competition with a moderate equipment, its mains already traverse the principal thoroughfares, it has organisation, engineering knowledge and experience, and upon the first real sign of competition there would be a lowering of charges all round. It is true that competition would result in much improvement for the consumer, and that might be a distinct gain, but how far the Vestry would be justified in improving the condition of the consumer at the expense of the ratepayers

is a moot point. There may be much to complain of in the legal machinery by which an offending company is brought to book, but judging by recent police court proceedings, there are provided a fair number of rods in pickle. The Metropolitan Company may not have conducted its business with foresight and judgment, but after all, electric lighting is comparatively new, and in the generation and distribution of electricity we have still much to learn.

It ought to be assumed that the company is doing its best to repair its shortcomings, and when its very existence is threatened there should be wanted no further spur to goad it to improvement. The *Times* says the new monopolist is rather more audacious than the old, and the department can only bid its suppliants wait till the clouds roll by or spend their money in trying to get penalties inflicted which, if inflicted, will not put a penny in their pockets. Without professing to understand our airy contemporary's reference to rolling clouds, we would just mention that there are certain enthusiasts in this country who considered that the charges made by various municipalities for electric lighting were so high that they proposed to generate electricity on a large scale and sell it to those municipal areas at much lower prices. In other words, the General Power Distributing Company proposed to sell electricity in various towns at much lower rates than prevailed, but the old monopolists, to wit, the corporations, prevailed upon Parliament to promptly kill the scheme.

CORRESPONDENCE.

Brierley's Signalling Apparatus.

I beg to thank you for your able and appreciative article on my patent railway signalling apparatus which appeared in your issue of December 29th.

In dealing with some of the forms of its application and the means provided in the shape of "tell-tales" in case of faults, you mention a few points which appear to require further elucidation. I shall be obliged, therefore, if you will kindly permit me to supplement the description of the apparatus which you gave.

In the first place, you say that "it would be interesting to know what number of engines were fitted with the apparatus, and the number of times they run over the fitted portions of the line, the speeds and the character of the trains." The apparatus has undergone a thoroughly practical and severe test, for about two years, on an engine with express passenger train running at an average speed of from 50 to 60 miles an hour. When the apparatus was fixed, I was informed by those having charge of the arrangements that it would be put to the severest possible test, and I believe that has been the case. Colonel Yorke, on behalf of the Board of Trade, has inspected the apparatus while working under severe test conditions, and has reported favourably upon it.

You further state that in other systems, requiring impact, breakages of the levers have not been infrequent. I can only say that, up to the present, this does not obtain with reference to mine. The levers stand the blows without breakages. The novel volute spring with double coils, in reverse order to each other, not only "takes up the energy imparted to the lever," but deals with it in such a manner as to prevent any mishap to the lever. How this is done may be somewhat difficult to understand, but it does it nevertheless. However, in case a lever should at any time break, I have attached a very simple "tell-tale" device to the levers which will inform the driver immediately a lever should either break or bend, so that it would not strike the rocker on the road.

The manner in which this is done is explained by the diagrams figs. 1, 1A, and 1B. Fig. 1 shows the device fixed on the levers of the apparatus on the engine. It will be noticed that there is a bar passing through studs, which are riveted on the inner sides of the levers. A front view of this is given on the detached lever, fig. 1A. The tension spring shown on the bar holds the boss on the top of the bar clear from the two brass studs shown at the base of the lever box on fig. 1B. These studs are electrically connected to the bell on the engine. If a lever should break or bend out of the line of contact with the rocker, the bar of the lever would drop and the boss on the top of the bar would press across the two brass studs and close an electric circuit. This would put the bell in continuous action. The driver in this instance would not be able to

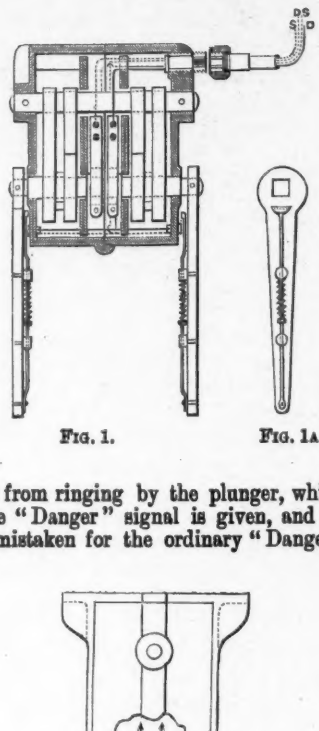


Fig. 1. Fig. 1A.

stop the bell from ringing by the plunger, which stops the bell when the "Danger" signal is given, and it could not therefore be mistaken for the ordinary "Danger" warning.

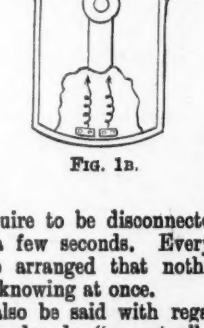


Fig. 1B.

The bell would require to be disconnected, which, however, could be done in a few seconds. Every part of the lever box is, in fact, so arranged that nothing can go wrong without the driver knowing at once.

The same may also be said with regard to the contact rocker. I have introduced a "repeater" in connection with the rocker, shown in figs. 2 and 2A. This device enables the

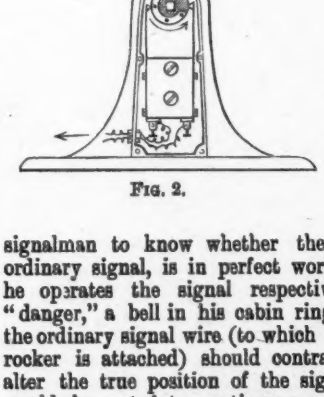


Fig. 2.

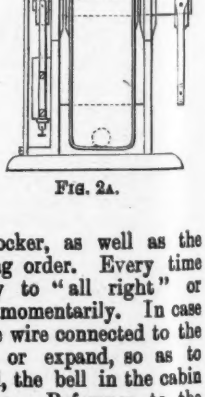


Fig. 2A.

signalman to know whether the rocker, as well as the ordinary signal, is in perfect working order. Every time he operates the signal respectively to "all right" or "danger," a bell in his cabin rings momentarily. In case the ordinary signal wire (to which the wire connected to the rocker is attached) should contract or expand, so as to alter the true position of the signal, the bell in the cabin would be put into continuous action. Reference to the contact springs resting on the disc shown in fig. 2, will explain how this is done. The disc is a compressed fibre, or insulating one, upon which is fitted a brass plate, covering two-thirds of the periphery of the disc.

One of the contact springs, it will be observed, rests upon the insulating part of the disc, and the other on the brass plate. Whilst the rocker is being moved from one position to another, both springs come in contact with the brass plate, and thus carry the current to the bell, until the rocker reaches its proper position, when it ceases. If anything should occur which prevents the rocker from rising or falling to the proper positions, both springs would remain in contact with the brass plate, thus keeping the bell in the cabin constantly ringing.

Fig. 2A shows an end view of the rocker, with the chamber of the "repeater," which is dust proof and watertight. As in the case of the levers, nothing has occurred up to the present in connection with the rocker, proving the absolute necessity of the "repeater." It can, however, be readily applied where thought desirable.

With regard to the provision for signals which are not *stop* signals, even when they occupy the "danger" position, my system admits of this being done by the fixing of contact bars at suitable distances from such signals, so as to give the driver the particular warning desired.

And also with respect to my "signal selector" and its uses, the Board of Trade inspector who examined it, as well as several railway experts, have informed me that I have gone as far in this direction as is necessary to meet the requirements of railway working with a supplementary signalling apparatus. Neither the Board of Trade nor railway companies, I was told, would ever dispense with the services of fogmen at junctions—although my system would dispense with the detonators—and that *directing* signals would only lead to complications of mechanism and liabilities of failure. I have therefore preferred to act upon their advice.

Your suggestion as to the necessity of platelayers being warned of the approach of trains direct, I agree with and provide for this being done. In addition to the driver having a warning of a special character given to him in such cases by means of bars (say three) being placed on the road, in the line of contact of the "all right" lever, so as to ring the bell three times in succession, a "treadle," such as is used to warn the signalman when the last vehicle has broken away, may be fixed at a suitable distance from where the platelayers are working. This "treadle" may be connected up to a portable bell to be fixed near the platelayers. It would be put in continuous action, until stopped by them, each time a train approached. Both platelayers and drivers would thus know simultaneously of each other's whereabouts.

In conclusion, I trust, Sir, that I have not written you at undue length. The importance of devices for the greater safety in railway working, and the attention which is at present being given to the subject, fully warrant, I think, the discussion which you have opened up by your able articles.

Wynford Brierley.

Alternating Measurement.

It is known to some of your readers that I have been engaged for several years in endeavouring to perfect a system of alternating measurement.

This system, after very careful consideration, I based on the use of electrostatic instruments.

The general type of instrument I have evolved for the purpose, particularly of an alternating wattmeter, I showed at the Physical Society last May. Owing, however, to the delightfully businesslike way in which the Physical Society conduct their affairs, the description of this instrument has not yet appeared in their *Journal*.

During the last year it has become increasingly apparent to me that in connection with this system of measurement it would be desirable to have what I call an "electrostatic ammeter." Strictly speaking, of course, such a term is a misnomer, though convenient in use, what is meant being really an electrostatic voltmeter capable of showing the small fall of potential across a low resistance.

For this purpose I have, during the last year, been engaged in trying to increase the sensitiveness of an electrostatic instrument which can be used either as a simple voltmeter or as an electrometer and suitable for use with alternating currents.

Some time since I succeeded in getting readings as high as 30 mm. for one volt difference of potential on a reflecting instrument with the scale at 2 metres distance.

Lately I have still further improved the sensitiveness, having been able to secure readings as high as 80 mm. for one volt with an instrument coupled up idiostatically or as a voltmeter, and with some care I think this deflection could be doubled.

Before the Physical Society I stated that my instrument was then about 12 times as sensitive as the types of electrometers usually employed.

As now arranged the instrument is about 200 to 250 times as sensitive as the Mascart type of instrument. Under these circumstances it is possible to detect voltages as low as one-tenth of a volt alternating, and as the capacity of the instrument is of the order of $\frac{1}{100000}$th of a microfarad, the quantity or amount of electricity which can be detected is extremely minute.

Having got so far, it struck me that I must be in the neighbourhood of being able to measure the voltage of telephone line currents, an object on which I started working about 15 years ago. Accordingly a fortnight since I coupled up a telephone transmitter to the instrument and commenced singing sustained notes into the mouthpiece.

I am gratified to say that the first attempt was successful, and I succeeded in getting a good deflection. Having since repeated the experiment before several well-known engineers I now feel justified in making the results public.

I estimate that with the usual type of instrument, the impressed voltage on the circuit, when speaking into the transmitter in the ordinary way, is between $\frac{1}{4}$ and $\frac{1}{2}$ of a volt. This is the average voltage produced on the secondary of the transmitter coil, by singing into the transmitter a note of about the same loudness and pitch as the average voice.

Knowing the other conditions of the circuit, a number of deductions can readily be made from this fact, but I prefer to wait a little to admit of the matter being gone into more carefully before generalising further.

G. L. Addenbrooke.

The Effect on Commutation of the Arc of Contact of Brushes.

In § 9, page 45 of your issue of January 12th, the conclusion is arrived at that commutation can never be improved by covering more than one commutator section with the brushes. This seems to me to be scarcely verified by experience. The paragraph ends, "This indicates that commutation cannot be effected in a weak field by the device of a thick brush."

Now, undoubtedly, the field may be so weak that sparkless commutation cannot be obtained with any sort of brush. Short of this condition, however, there is frequently a stage where sparking will occur if one section only is covered, but can be prevented by covering more than one. This is especially noticeable with slotted armatures.

The error in your argument seems to me to lie in the sentence, "If the flux in the armature due to one of these coils having a current c is $l\,c$, it may be seen that the flux in coil A may be represented approximately by $4\,l\,c$ in one direction, and that in B by $4\,l\,c$ in the other direction." I should be glad of an explanation as to how this may be seen.

Considering your fig. 8, page 45, it seems that the flux in coil A is produced by c in A, and $\frac{c}{2}$ in the coil next to A. The effect of coils on other side of A, in which the current has its full value, c is neglected as you explain in § 6; since they only help in producing the stationary field distortion.

Let $\psi_4\ \phi_4$ represent the values of ψ and ϕ, when four bars are covered.

Then, approximately:—

$$\psi_4 = \tfrac{3}{2}\,l\,c \therefore \phi_4 = 3\,l\,c.$$

Suppose stray field, entering between A and B, is in both cases uniform and of flux densities, B_1 and B_4, respectively.

Let $\phi_1 = k\,B_1$

then $\phi_4 = 4\,k\,B_4$.

From above $\phi_1 = 2\,l\,c, \quad \phi_4 = 3\,l\,c.$

$$\therefore \frac{B_4}{B_1} = \frac{\phi_4}{4\,\phi_1} = \frac{3}{8}$$

i.e., the field need only be $\frac{3}{8}$ as strong to secure commutation when four bars are covered.

If the above reasoning is correct it might be expected that the arc of contact might with advantage be made greater than is found possible in practice.

The discrepancy is probably almost entirely due to want of uniformity of the field which acts on the coils during commutation. If the arc of contact is much increased, still less uniform parts of the field may be brought into action. This will cause large local currents circulating through the coils and brushes which are prejudicial to good commutation.

David Rew.

Liverpool, *January 20th.*

The Use of Rubber-Insulated Wire in Steel Conduits.

If Mr. Zingler had read anything but the words "300-megohm wire" in my letter, he would not have referred to an assumption which he himself seems to have originated.

He assumes that his article was not read carefully, which is incorrect, although it was not fully dealt with.

He also assumes that I am "slinging"—whatever that may mean—wire into conduits, which is also quite incorrect.

He further assumes that 300-megohm wire is the standard grade in insulating conduit work. The wording certainly justifies this assumption to some extent.

The only reason this grade of wire was mentioned is, that in his original papers on iron pipe *v.* conduit he allows this grade of wire as being "best work." Has he changed front on this point too?

I cannot help feeling that Mr. Zingler lays too much stress on the insulation test from bare wire to earth, through the insulating lining of the tube.

For twin wiring work I am inclined to regard this quality more as an incidental, and the physical properties of the tube as being the more important.

1. The pipe and bends are very smooth inside, thus permitting easy insertion and withdrawal of the wires, and entirely doing away with risk of damage to wire, either by cutting, scraping, or stretching.

2. The pipe is watertight, thus preventing access of moisture by leakage.

3. The insulating lining being a poor conductor of heat almost entirely prevents any condensation of moisture from outside air, even if the covers of boxes are removed, in fact, trouble from this cause is practically unknown.

Thus the conditions under which the wire is placed are not nearly so severe as in the case of unlined pipe, particularly Simplex, and therefore the same result can be obtained with lower grade wire, *and can be relied on to last.*

As regards the man who can pull, his place is certainly with the gas pipe and Simplex tube, where he will be needed, unless the tube is threaded on the wire, as is often done with the latter system, which offers particular inducements to the full-blown store-boy class.

I cannot understand how the insulated system can be regarded as open to abuse by the jerry wirer as regards the wire. He may put in unlined tube if not looked after, but how can the wiring be scamped when any length can be withdrawn and inspected at will.

Before closing, I should be glad to know how to reconcile Mr. Zingler's statement in the first place, that uninsulated pipe requires the best workmanship, and "should not be attempted," &c., with his later information that Simplex was introduced in order to suit the capabilities of the full-blown store-boy-class of wireman. Is this Mr. Zingler's idea of *best work?* If so, the breakdown of wire is easily understood.

W. H. Isherwood.

Randalstown, co. Antrim.

The Smelting Corporation.

Referring to Mr. Kershaw's short outline of this corporation's process, which appears in your issue of the 19th inst., on page 85, will you allow me to correct one error, which has, no doubt, inadvertently crept in. When the total outlay of £250,000 has been spent upon our works, their full capacity will be 2,100 tons complex sulphide ores per week, and not 700.

Frederic S. Bishop, *Secretary.*
THE SMELTING CORPORATION, LIMITED.

London, E.C., *January 23rd,* 1900.

Sterilisation of Water by Ozone.

I deeply regret that Mr. John B. Kershaw did not pay me a visit at my laboratory while I was conducting my last series of experiments on the sterilisation of water. He would have been welcome, and not only would he have had from me the most complete information on the technical part of the ozonisation of water, but he would have also seen the bacteriologist who had the experiments under his supervision, who is one of the most competent men in this country on such questions, and who would have explained to him our programme.

But for a severe illness, I would have written for the ELECTRICAL REVIEW a statement of the results obtained; I hope I will soon be in a position to do it.

I am glad to hear that the municipality of Lille has adopted the Marmier-Abraham system, because these two scientists use my own apparatus. There is no such thing as a Bertolus ozoniser.

Messrs. Marmier and Abraham sterilise water by means of my own hollow point-bearing electrodes, through which there is an independent circulation of water for each set of electrodes.

At Charlottenburg, the calculation is made in the following manner:—The yield of ozone is 20 grammes O_1 per hour, *i.e.*, 60 grammes O_3. 1 kilo. of active ozone cost 3.255 marks; 1 gramme of active ozone costs, therefore, 0.3255 pfennig, on the condition that the cost of the H.P.-hour does not exceed 3.1 pfennige. Everyone seems to have his own method of estimation; I think it is much better to take notice only of the watts spent. I do not think it is accurate to say that the price of the H.P.-hour is 1½d. I take it as granted that the KW.-hour costs only 1d., therefore my sterilisation of water is not expensive.

To this, although it has nothing to do with the destruction of microbes by ozone, I will add, that, to complete the list of the application of ozone in the manufacture of artificial perfumes near Paris, 80 KW. are consumed for the production of ozone required, which represent for 24 hours, 1,920 KW.-hours.

At Noyon, Mr. Verley has treated syrups in a sugar factory by a combination of ozone with a chemical process. The results have been very satisfactory. The quantity of syrup treated was 200 tons per day; the installation consisted of 100 H.P., one alternator 300 amperes, 250 volts = 75,000 watt-hours, 10 transformers 12,000 volts and 100 ozonisers.

This is what may be called practical work.

E. Andreoli.

The Century Problem.

In spite of your wish to the contrary, I cannot refrain from putting, in a few words, what I think is the crux of the whole controversy, leaving it to your good judgment as to whether its insertion will enlighten your correspondents or not.

Shortly then, the astronomers "measure time" whilst ordinary mortals simply "ticket each period with a distinguishing sign."

Example: Sir Norman Lockyer would enter the publication of this issue as:

(1) 1900 years, 0 months, 25 days, 12 hours after the birth of Our Lord;

whilst the man in the street would say it was published on the:

(2) 26th day, 1st month, 1900th year.

It is at once clear that the last date is one in advance of the astronomical one in every item except years.

Now in the beginning it is reasonable to conclude that years were dealt with in the same manner as months and days, that is to say, the first day of the Christian era would have been described as:

(3) 1st day, 1st month, 1st year of Our Lord;

and consequently, when the second Year of Grace commenced, the astronomers would be writing it as :

(4) 1 year, 0 months, 0 days.

If this is granted, Sir Norman should write, in place of (1), the following :

(5) 1899 years, 0 months, 25 days ;

when it is evident that both (2) and (5) show next January 1st to be the first day of the 20th century.

C. B. Nixon.

Manchester, *January 21st*, 1900.

P.S.—It is indeed impossible to prove which method was adopted in the beginning, but I cannot imagine anyone writing of the 0th Year of Grace.

I hope it won't grieve you greatly if I just mention my reason for concluding that 1901 begins the 20th century. I haven't seen it elsewhere, but it seems to me absolutely conclusive, if a century means 100 years.

It is just this, in a century there are 100 years, and each year has 365 days, consequently in a century there must be 36,500 days. Therefore the first century must have come to a close with the end of 100, and the second century must have begun with 101, and so with the succeeding centuries.

Put it in another way. If you had a number of volumes, each with 365 pages, arranged in centuries, the first row must end with vol. 100, otherwise it would not be complete; the second row would begin with vol. 101, and so on.

There may be a loose and popular way of speaking of the close of the century, or of the beginning of the century, which would acknowledge all the years beginning with the same figures as belonging to the same group, but it would not be accurate.

Hadrian Harries.

Ealing, *January 23rd*, 1900.

Might I trespass upon your valuable space to say that I fully endorse your statements with regard to the new century? The reasoning of Mr. May in your issue of the 19th inst. is, to say the least of it, amusing ; and might I ask that gentleman if he would like to receive a dot for the first £1 of his income, and a sovereign for the second, and so on? Mr. Tasker's bicycle analogy, to my mind, explains the century *difficulty* (if it can be called so) admirably, because, if Mr. Tasker dismounted from his bicycle after he had ridden, say, 4 furlongs, and looked at his cyclometer, he would find that he had traversed one-half of the first mile, not one-half of the nought mile. Now, we say to-day *is* the 24th of January. What we mean is, that we are in the 24th day—not that we have completed 24 days—and also that we are in the year 1900—not that we have passed through 1900 years. Can anything be simpler?

Robt. B. A. Ellis.

Westminster, *January 24th*, 1900.
Nineteenth Century.

[Our correspondents this week put forward arguments, some of which are very ingenious, while others more or less closely resemble those contained in our own note and comments. All of them are in agreement with our views. As the continuation of this discussion would profit no one, and the pressure on our space is extreme, we propose to publish no more letters on the subject.

What Ho!

Either your "printer's devil," or some "biased" reporter has served you false. In the description of the I.E.E. meeting in your last issue, you evidently meant to intimate that the General Electric Company—the members of which firm are Messrs. G. & M. Byng and Mr. Hugo Hirst—had generously presented 100 guineas to the Institution building fund.

I regret that I cannot yet claim to be one of the generous "3-phase" donors, for although it is true that the G.E. Co. was the enterprising firm which first gave me "a leg up" with my work, I fear my present "status" would not enable me to be as liberal as you have inadvertently made me appear.

Will you please advise whichever it may be of the "erring" gentlemen, that there is in the electrical field a "live" and good "Hirst" (Hugo Hirst), whilst I am only the "bad" Hurst—so often pecked at by editor, contractor, and competitor alike! Please also let him understand that whilst I have but few *hard-earned dollars*, I fully sympathise with the Institution building fund, and that when the hat is passed round I will throw in my "mite," even if this should only be "a medal."

Fred. Bathurst.

[We regret having inadvertently charged Mr. Bathurst with generosity! By quite a slip of the pen last week we referred to Messrs. Byng, Bathurst, and another, instead of Byng, Hirst, and another.—Eds. Elec. Rev.]

Electric Cranes.

I notice in your issue of the 12th a paragraph announcing a large electrical crane equipment for Middlesboro' Docks, and it is stated that this will be the largest plant of the kind in this country.

I beg to point out that this statement is hardly correct, as the Lancashire and Yorkshire Railway Company have already in Manchester a generating station of the same power, viz., 1,000 E.H.P. in operation, working 24 capstans, a wagon hoist, 6 cranes, and a large number of smaller motors used for various purposes, and, in addition, there is a considerable amount of lighting from the same station.

This company have also an electrical power station of still larger output in connection with their Horwich works which has been in operation for upwards of two years. I beg to enclose my card.

H. Jackson.

Horwich, Lancashire.
January 22nd, 1900.

The City of London Electric Lighting Company and the Scarcity of Coal.

I notice in your issue of the 19th inst. that you refer to the difficulties under which the supply to the City is now being given, and I shall be glad if you will kindly allow me to point out how variations in the coal supplies affect the output of boilers, particularly when mechanical stokers are used.

We are at present using two types of mechanical stokers, and hand firing in other cases. There is, of course, at present no difficulty in obtaining deliveries of large Welsh coal suitable for hand firing ; it is merely a question of expense ; but with mechanical stokers the selection of suitable fuel is limited according to the type of stoker. For the majority of our boilers we require a coking coal, and arranged for contract supplies during last Autumn sufficient to last us for more than one year ; these supplies were purchased from four or five different contractors and merchants, and, presumably owing to the disorganisation of the coal trade, nearly all these contractors have declared their inability to fulfil their obligations at the present time, and they are now in default to the extent of arrears amounting to more than 10,000 tons of good fuel. In some cases they have submitted other coal in substitution of their contract deliveries, and systematic tests have been carried out to ascertain the merits and capabilities of these "scratch" deliveries. The unsatisfactory nature of the fuel thus supplied has compelled us to make our own purchases from the collieries, and we can fully appreciate the difficulties of carrying on the coal trade at the present time.

The whole question of the fuel supply of this country requires consideration, and I venture to think that such a source of national prosperity should no longer be allowed to play pranks on its own account, but receive the careful attention of the Legislature. I note in your "Leader" that some reference is made to the probable causes of the present scarcity of fuel, and it is significant to note that the reasons given by those interested, either in collieries, railways, or the trade, generally vary according to taste. The colliers

appear to be earning more money than they require, and thus prefer to limit their work to four days a week, probably working out a little problem in political economy to their satisfaction, for they appear to have satisfied themselves that if they can successfully curtail the output, the prices realised by the owners will enable higher wages to be struck for. Colliery owners are probably regretting the reduced output, particularly at such a time of trade activity; but, on the other hand, the railway companies, with their inadequate facilities for handling their traffic, are probably the only people who are satisfied with the present arrangements; in fact, assuming that the full output was being obtained from the collieries, it is difficult to see how the railway companies would be in any better position to deal with the increased quantity than they are at present with the hopelessly inadequate supplies.

I send you herewith two curves, showing results of tests on the dates you mention. These tests, of course, refer only to one boiler, but are sufficiently illustrative of the value of the fuel. Sheet No. 2 gives the result of burning one of our contract supplies, and you will notice that the water evaporation per hour was 14,025 lbs. This supply was unloaded on the previous day, but on the 8th inst. we had to avail ourselves of very inferior fuel, which reduced the output of each boiler to 8,000 lbs. per hour, and caused the greatest difficulty in keeping the fires going satisfactorily; the depth of coal feed had to be cut down to 3 inches, and large masses of hard clinker were formed, of which I send you a specimen. Such villainous clinker is rarely met with during ordinary working, and no colliery with a reputation to keep up or lose would dare to send out such imperfectly screened coal. I also send you an actual sample of this bad coal, and of our good contract coal, and trust you will see by actual demonstration in your office grate that whereas our contract coal will be a good deal warmer than your leader and remarks in your issue of the 19th inst., the inferior coal will, I hope, successfully put your fire out.

The particulars given in our tests explain themselves, and I may mention these tests are merely part of the duties undertaken by our testing department under Mr. Peard, and we are endeavouring to systematise the purchase and use of fuel by careful records, though we fear we shall never be able to obtain coal to specification, nor to pay for it according to its calorific value. I have omitted all reference to cost of fuel, &c., in these copies of our tests, and I shall be happy to show you the serious result of attempting to use inferior fuel, and of purchasing it at the present time.

In conclusion, I would remind you that although hand firing furnaces are more convenient for use, yet when any trouble causes diminution of supplies from the Welsh coalfield and other coal has to be used, serious trouble is the result, and magistrates are inclined to suggest that coking stokers, or other appliances, should be used to prevent smoke; so that we have the happy combination of a number of troubles, and no clear way out the difficulty.

Frank Bailey.

January 23rd, 1900.

[After reading the foregoing explanation of the City Company's troubles, we feel bound to extend our hearty sympathy to Mr. Bailey. It is easy to understand that with such miserable fuel as the sample sent us, no boiler could be expected to maintain an adequate supply of steam, and without steam no effort on the part of the staff can keep the pressure up. The contrast between the "contract" sample and the inferior sample is most striking, and the clinker is exactly like the stuff we have seen taken out of refuse destructors!

The curves and data show that whereas with the good coal 14,025 lbs. of water were evaporated per hour, at the rate of 6·96 lbs. per pound of fuel, using 11·8 lbs. air per pound of fuel, and obtaining 8 25 to 9 per cent. of CO_2 in the waste gases; the figures with the "muck" were 8,010 lbs. water per hour, at the rate of 5·65 lbs. per pound of fuel, using 25·3 lbs. air per pound of fuel, and obtaining only 3·3 to 4·3 per cent. of CO_2. These figures speak for themselves; moreover, the tests were made on January 12th and 8th, which were respectively a good day and a bad one.

We trust that Mr. Bailey's difficulties may soon be matters of the past.—EDS. ELEC. REV.]

A Problem in Dynamo Design.

I should be pleased if you or some of your readers would give a full solution in your paper to the following problem taken from the City and Guilds examination papers in electric lighting:—Calculate the size, resistance and weight of copper wire such that, if wound on a magnet core 7 inches by 3½ inches, and having a potential difference of 25 volts maintained between the terminals, 5,000 ampere-turns will be produced. Length inside the former is 8 inches (City and Guilds Examination in Electric Lighting, 1898).

Thanking you in anticipation.

Student.

[Let ρ be the resistance of a copper wire 1 foot long and 1 mil in diameter;
d the diameter of the wire in mils;
p the mean length in feet of one turn of the winding;
t the number of turns of wire;
A the current flowing in the wire;
V the potential difference maintained between the terminals.

Then the resistance of the winding is $\frac{p\,t\,\rho}{d^2}$

and $$\text{A} = \frac{\text{V}\,d^2}{p\,t\,\rho},$$

whence $$d = \sqrt{\frac{p\,\text{A}\,t\,\rho}{\text{V}}}.$$

In this expression A t is the ampere-turns.

The problem is therefore solved by inserting the values for the mean length of turn, ampere-turns required, resistance per mil-foot of copper at the working temperature, and the pressure, in the above formula.

This gives the *least* diameter with which the required ampere-turns can possibly be obtained; any larger wire will, of course, give a greater number of ampere-turns in the ratio of the cross-sections.

It will be seen that this result is independent of the length of bobbin, of the thickness of insulation, and even of the depth of winding if the value of p is fixed; it is of the greatest value in the design of dynamos. Allowing ¼ inch for insulation, &c., depth of winding 1 inch, $p = 26$ inches $= 2{\cdot}17$ feet; ρ is 12 ohms at 60° C. Hence $d = 72$ mils.

$$\text{No. of turns } t = \frac{\text{length} \times \text{depth}}{(\text{Drain, overall})^2} = \frac{8 \times 1}{{\cdot}087^2} = 1{,}060.$$

$$\text{Resistance} = \frac{p\,t\,\rho}{d^2} = 5{\cdot}3\ \omega.$$

$$\text{Weight} = p\,t\,d^2 \times 3 \times 10^{-6} = 36 \text{ lbs.}$$

—EDS. ELEC. REV.]

LEGAL.

THE MAYOR, &c., OF CARDIFF *v.* MESSRS. FERRANTI, LIMITED.

Case settled.

ON Thursday last week (January 18th) the hearing was commenced in the Queen's Bench Division of the High Court of Justice, before Mr. Justice Mathew, sitting without a jury, of an action in which the Mayor, &c., of Cardiff, were the plaintiffs, and Messrs. S. Z. de Ferranti and others, the defendants. The plaintiffs sought to recover damages through delay on the part of the defendants in supplying an alternator for the electricity works. Messrs. Ferranti denied liability and counterclaimed.

Mr. A. T. Lawrence, Q.C., with Mr. Leslie, appeared on behalf of the plaintiffs; and defendants were represented by Mr. Jos. Walton, Q.C., Mr. Frederick N. Laing, Q.C., and Mr. Bulloch.

In opening the case for the plaintiffs,

Mr. LAWRENCE, Q.C., said that in March, 1896, the defendants, Messrs. Ferranti, Limited, tendered to supply a 300 H.P. steam alternator at the price of £3,250, and a contract was entered into on June 4th following between the defendants and the plaintiffs, it being a condition of the agreement that the work should be completed to the satisfaction of the borough engineer, and handed over to the plaintiff Corporation by September 15th, 1896, failing which, the defendants were to pay the Corporation 1 per cent. on the contract price per week, during such period as the work might remain uncompleted. The work was not finished in time, and a correspondence ensued between the parties which extended over three years, defendants' letters being more or less to the effect that they (defendants) admitted the delay and thanked the borough engineer for his leniency.

Mr. WALTON Q.C., interposing, said it was a question when the contract was completed, and that was of importance, because the penalty being £31 10s. per week, now amounted to £5,000 or £6,000. The defendants had paid £1,500 into Court, while not

admitting their liability, and they had already spent £7,000 upon the work. There was also a question of law whether the Corporation could recover damages, the penalty of £31 10s. per week, counsel observed, being in the nature of damages.

Mr. LAWRENCE remarked that the electric light had suffered because of its condition, through the competition of the incandescent gas light; and that might be shown to be a source of danger.

His LORDSHIP said the matter seemed one for adjustment, and

Mr. WALTON intimated that it was probable the parties might approach each other over night and do the best they could to arrive at a settlement.

The hearing was then adjourned, and on the 19th inst., when the case was resumed,

Mr. LAWRENCE, Q.C., informed his Lordship that an endeavour had been made to come to terms, and these were then being considered.

Half an hour later the parties returned to Court, and Mr. WALTON, Q.C., said he was glad to be able to state that he and his learned friends on the other side, with their clients had arranged the matter. The record would be withdrawn on terms, which, if necessary, could be embodied in an order of Court. All he (counsel) asked at present was that it should be ordered that the £1,500 which defendants had paid into Court should be paid out to the plaintiffs.

His LORDSHIP: Yes. There will be an order as applied for.

A Cardiff paper says that the case was settled on the following terms:—The defendants to pay the plaintiffs £2,000 (including the money in court). The plaintiffs to pay the defendants the balance of cost price (£325). The defendants to execute the following works within one month from proper facilities given:—

1. Adjust the governor, so that the engine will govern to Mr. Burstall's satisfaction.
2. Make or replace the journals on vertical shafts to Mr. Burstall's satisfaction.
3. Put the gearing of the vertical shafts in order to Mr. Burstall's satisfaction.

No costs on either side, and the judge's order to be taken if necessary.

ALLAN *v.* CUMBERLAND.

THIS was an action tried by His Honour, Judge Lumley Smith, Q.C., in the Westminster County Court, on Friday, January 19th, brought by Messrs. Allan & Co., electricians, of Hatton Garden, to recover £5 from the defendant, a publican in Bond Street. Defendant paid 30s. into Court, and the dispute had reference to two arc lamps which plaintiffs had to repair. Their case was that the lamps were specially made by Messrs. Moody Bros., for the Westminster Electric Supply Corporation, who by increasing the voltage rendered the other lamps unuseable. At the time Messrs. Moody said that the lamps were too short, the mechanism being too near the arc. Sometime after plaintiffs had instructions to repair them, but pointed out that it was highly improbable that they would be of any use, and he had better have new ones, but this he said they only wanted to get a larger order. The lamps did not work satisfactorily, though Messrs. Moody did all that could be done, and when tried in their works they were all right. It was also said that defendant's men had put linseed oil in them. Defendant said they never worked more than half-an-hour at a time, and denied that his people had used linseed oil.

His HONOUR said the work done was useless, and defendant was not bound to pay. There would be judgment for the 30s. paid into Court, with costs.

RUCKER *v.* THE LONDON ELECTRIC SUPPLY CORPORATION, LIMITED.

FIRST DAY—MONDAY.

In the Chancery Division of the High Courts of Justice, London, on Monday, Mr. Justice Farwell commenced the hearing of the action of Rucker *v.* The London Electric Supply Corporation, Limited, which is one for an account of damages for alleged infringement of a patent (No. 3,379, of 1885) for "Improvements in Distributing Electricity, and Apparatus therefor." Mr. Bousfield, Q.C., Mr. A. J. Walter, and Mr. J. H. Gray were the counsel for the plaintiff; and for the defendants there were Mr. J. Fletcher Moulton, Q.C., Mr. C. A. Cripps, Q.C., Mr. J. C. Graham, and Mr. Hugh Moulton, the last named appearing for the first time at the bar, of which his father is so prominent a member. The case is expected to last over a week, but at the outset Mr. Bousfield stated that he was willing to call only two experts if the other side would agree to the same course.

Mr. BOUSFIELD, in opening the case for the plaintiff, said that the case was one which referred to their patent for a system of distributing electricity by means of transformers arranged in a certain combination. He could only recall one similar case. It was somewhat similar to Dr. Hopkinson's case of a certain combination of transformers, mains, secondary circuits, lamps, and so on, for the purpose of distributing electricity. Twenty years ago distribution was practically unknown. They had the light in lighthouses, where the dynamo at the bottom of the tower furnished the light above. But the idea of distributing electricity—the hope of the possibility of it was in everybody's mind, but the realisation of it was entirely in the future—was scarcely known. Considerable strides have since been made towards the fulfilment of the hope. One of the greatest is that which has been made by the patentee under the present patent. Of course, the patent is Thompson's, No. 3,379 of 1885, but Thompson is only a patent agent. The real people are two Continental electricians to whom this improvement is due, Zipernowsky and Déri. They made this improvement in 1885, and they patented it in various countries on the Continent. They are connected with Messrs. Gans & Co., who are well known in the electrical industry of this country.

Mr. FLETCHER MOULTON at this stage intimated that it had been agreed between the parties that they should contribute initially equally towards the shorthand notes in print, but that ultimately the cost should become costs in the case.

Mr. BOUSFIELD, resuming, said that Messrs. Gans & Co. were great electrical manufacturers. There had been a number of foreign patents, and he would explain what might seem a strange circumstance that this matter should arise so late in the life of the patent.

Mr. FLETCHER MOULTON: It is absolutely post mortem.

Mr. BOUSFIELD: But it had begun before. The fact was that Messrs. GANZ, who had a very large business on the Continent, had a great deal of litigation on the Continent in regard to it. That was one element. They were unfortunate in their first litigation, but finally they succeeded in their litigation in Italy and France. During all the time they were extending their business on the Continent and their hands were very full; and the difficulty they had when they came before the Privy Council asking an extension of the patent was to show that they had been making their best efforts to push this invention during the last 14 years. That difficulty they did not have in this Court.

His LORDSHIP: You could not ask for an injunction now, or delivering up of the infringing articles, you ask simply for an account.

Mr. BOUSFIELD said that that was all. Another curious element was this. For some time after the installation of this patent, although they had exhibited it in 1886, yet there were leading engineers and electricians who condemned the system, who prophesied that it would not work, and that successful distribution could not be attained under that patent. Some of these were people who, as they knew occasionally in such cases, would come now and say it was perfectly obvious from the first that the system must succeed. But in 1886 it was very different, and it was on record that scientists and electricians in journals and electrical papers prophesied that it would be a failure. They had had those initial difficulties to encounter, with the added difficulty that the people interested on the Continent were experiencing great difficulties in litigation there. It was only when they succeeded in overcoming those difficulties that they had been able to turn their attention to the infringement which was going on in England. It was now three or four years since the patent was amended and bought by the plaintiff in this action. The amendment was simply the cutting out of specific apparatus. He would not trouble the Court with what that was at this stage, but he did not think it could be suggested that in cutting out that specific apparatus from the original specification there was any want of that good faith or reasonable skill in knowledge which was necessary to entitle any person to damages in respect of the infringement of the amendment.

Mr. FLETCHER MOULTON: The amendment is 12 years old.

Mr. BOUSFIELD said that, of course, it had been amended solely in view of the litigation, and to remove matters of little importance outside the field of controversy by deleting them. If they had been there, there might have been three times the number and form of the objections, and this had therefore been only a matter of simplification. The invention had reference, as he had said, to distribution of electricity by transformers. By means of that system generally they were enabled to use electric currents of high tension, carry them near to the points of distribution and separate them into currents of low tension. He might have to explain some of the terms.

His LORDSHIP: I am afraid that you will have to treat me as a novice and instruct me a good deal.

Mr. BOUSFIELD said he would not on that day explain those terms, but there were elementary terms which one had to explain in a specification. When his Lordship had mastered the terminology of the thing which involved certain elementary principles, his Lordship would be able to master this litigation. The principles involved were really simple, and if he could make them clear in his opening as matters not of controversy, the evidence ought not to be of very great length. There was a certain controversy which alleged that this patent had been anticipated by something done by Gaulard and Gibbs and at the Royal Aquarium. At this point Mr. Bousfield interrupted his speech by referring again to the question of the number of expert witnesses to be called, and asked if his learned friend agreed with him that each side should have only two experts.

Mr. FLETCHER MOULTON said he would make the evidence as short as he could without binding himself to that arrangement.

His LORDSHIP said that Mr. Justice Romer had restricted expert evidence to two witnesses on each side. He, however, would leave it to counsel's discretion, as it might be that someone might be a specialist in a particular branch.

Mr. BOUSFIELD said that he knew that his Lordship would not desire to cramp them. He only wished to protect himself, so that if he called only two witnesses, and his learned friend brought four, he should not be told that the weight of evidence was against him.

At this stage the Court adjourned for the day.

SECOND DAY—TUESDAY.

On Tuesday, Mr. BOUSFIELD, continuing his speech in opening the case, said that the problem had to do with the distribution and flow of electricity through wires, and therefore it was analogous to the distribution of gas or water through pipes, and the analogy of sending a flow through pipes helped them very much. The flow of water depended upon differences of pressure or of level. The fall of pressure of water depended on the resistance which was passed through and the distance traversed; and that analogy held good in the case of an electric current. The learned counsel proceeded to explain certain technical terms perfectly familiar to experts in electrical science, and then reverted to the state of knowledge as to that science between 20 and 30 years ago. It was necessary to have a machine to each light, and then came the arc which presented a certain resistance, The next thing was to have a machine which gave higher pressure.

and to light two, three, four, five, or six lamps by that means. That was the problem of electric distribution. They attained to the "constant current system" of distribution with arc lights. Then they had the second system, by which if they had six lamps they must have six half-amperes, or if 1,000 lamps, 500 amperes flowing in the direction of the dynamo, and what they had to do then at the station in order to keep the pressure, was to do it not by the amperemeter but a voltmeter to show that the pressure was constant. But there were drawbacks to both these systems of distribution; and so they came to the constant potential or constant pressure system, instead of the constant current system. One defect of that system was that if the branch was, say, a mile long, they could not have the conductor so big as to have no fall of pressure from one end to the other. Nor did they get the constant pressure which they ought to have at all the different points along the line. The effort was to maintain the whole of the lamps on the line at 100 volts potential, and by means of the Edison system with feeders they were able to get an approximation to it, but only an approximation. It was fairly good for small areas, but as they increased the number of lamps and the area of distribution it became economically unworkable, just as the earlier methods, when the distribution was expanded, became dangerous in practical working. The next great step in the matter was Hopkinson's three-wire system, by means of which a saving of practically three-fourths of the copper previously required was effected. That enabled them, with a given capital, to cover a much wider area, and that was an important matter in connection with this case. That helped them to see what people were driving at for years. Supposing they had a certain area, say, of 1,000 lamps, each lamp took half an ampere at a pressure of 100 volts, so that the whole system took 50,000 ampere volts, or 50,000 units of work per second. Now, in distributing those 50,000 units of work, the question was how to do it most economically; and it was obvious, having regard to the question of current and of waste of current from resistance, that if, instead of sending the current from the station 500 amperes at 100 volts, they sent out 100 amperes at 500 volts, they were sending out the same amount of work, but the conductor would be so much smaller and the expenditure would be so much smaller. It was, therefore, seen to be desirable to send out at a higher potential, and that having been obtained, the Ruhmkorff apparatus was the earliest method and the simplest form of transformers for the purpose. Gaulard and Gibbs had in view the reducing of the size of the lamps and diminishing the energy of the conductors at a high potential. Speaking of the plaintiff's patent, the learned counsel pointed out that the object of the invention was to make all individual points of consumption of electrical energy quite independent of one another. Lord Kelvin might say that that was a simple thing to do, and that there was nothing in it. He (counsel) assumed that Mr. Moulton would say that the thing depended upon such elementary electrical principles that it required no application of skill to make it effective. He should point out, however, that so little did it appear obvious to electrical authorities in the past that the principle was condemned all round, viz., at discussions, in the Courts, and in papers read at meetings, and so on. It was received with discredit and disbelief in the electrical world. In the three-wire case it was said that anybody would know that if two conductors were put together, in one of which there was a current flowing one way, and another the other, the two currents would be naught. Of course that was so. Two currents of that sort neutralised one another. Although the principle of the plaintiff's invention might be obvious, it did not follow that there was no application required to make it effective. The plaintiff's case depended on the fact that the patentee had put together all the elements of knowledge, and applied them to a practical system of electric lighting. The learned counsel then read the complete specification, No. 3,079, of 1885, and said that the claim made by the patentee was the application of induction coils or transformers for alternating electric currents, the arrangement of several stations of second order as branch circuits of the main line, viz., in connecting up the local centres with the main line in multiple arc, to which main line is supplied an alternating electric current of a tension as constant as possible. The defendants' system was on the following plan:—At Deptford they generated their electricity at a tension of 10,000 volts and brought it into London. Their mains were carefully guarded against leakage. The defendants made a double use of this system, but the important thing to observe was what they did when they got the current to Trafalgar Square. The defendants got it there as electrical energy for distribution at 2,000 volts. As a matter of fact, the defendants made double use of the transformer system; they applied this system for distributing throughout the district they supplied. They had got their mains laid down in the streets at a pressure of 2,400 volts, then they had the sub-stations where they had the transformers.

In answer to the JUDGE, the learned COUNSEL said on the question of infringement, the defendants said that the tension of the plaintiff's system varied from time to time in order to get the best results. That was merely a quibble. This was a constant tension system, as opposed to a constant current system. The specification was amended three years ago, and in that respect there was also an analogy to the case of Hopkinson whose specification also was amended, and who had to satisfy the Court in order to obtain damage that before the amendment the original claim was framed in good faith and with reasonable knowledge. In these cases they had to satisfy the Court that the original claim was framed in good faith and with reasonable knowledge, instead of getting the better of the public by first making a broad claim and then cutting it down. In the present case, he would show that those familiar with the knowledge of the time would see nothing against the good faith or reasonable skill and knowledge required by the Act; and the object in making the amendment had been simply to lighten the ship by getting rid of points of dispute.

The first witness examined was Mr. JAS. SWINBURNE, who, in answer to Mr. WALTER, said he was an electrical engineer, and for many years had closely associated himself with the development of electric lighting. He laid down his first transformer at the end of 1882. Formerly each arc lamp had its own dynamo. In the year 1878 the newspapers were full of the subject of the sub-division of the electric light. Electrical power was got by multiplying the current by the pressure—each lamp took a given amount of power. It was really very important to get high pressure for distribution. The importance of high pressure for distribution had been realised for a long time. It was wanted ever since it was talked about at all. As regarded the question of the independence of the lamps, they must either have the whole going at that time or all the lamps out. It could be used in public restaurants and ships, where the lights were all put out together; but that was not convenient where the consumer desired to be free to turn out what lamps he pleased. The Hopkinson system patent was taken out in 1882; Gaulard and Gibbs was another system of distribution with transformers. The main object of a transformer was to fulfil its name. It transformed the current; and the current of electricity flowing in one wire was made to have effect in another wire, inducing a current in that second wire. The Gaulard and Gibbs invention (exhibited in diagram before the Court) was used at several of the Metropolitan Railway Stations. It was not a system of distribution for extinguishing individual lamps at all. What was wanted in a system of distribution was constant tension or pressure on the lamps, and a small amount of copper on the mains, that involved other things. A small amount of copper in the mains involved sending out at high pressure. The incandescent lamp involved low pressure. As regarded any system of electric distribution, the lamps ought all to be perfectly independent, and each customer ought to have his supply as he wanted it, independent of anybody else. The invention described in the specification now under consideration dealt with the difficulty of requiring low pressure on the lamps and constant tension upon them. They wanted high pressure at the station, and they wanted an arrangement by which the lamps could be turned out one at a time. The inventor had solved that difficulty, and no previous system of distribution had met it in his way. The invention enabled an extended system of distribution to take place, under which it would be possible to distribute over large districts from the central station. The specification showed that the inventor had thoroughly understood the subject of transformers, and no statements like those which appeared in the specification were to be found anywhere else, as far as he knew. The invention which was claimed was precisely as described in the complete specification.

Was it really useful?—I think it was.

And was it novel?—Yes, I think it was; and it was properly described in the specification.

Continuing, WITNESS said he was acquainted with the system of distribution of the defendant company. In his opinion it was exactly the same as that of the specification. They had additional means of transforming, because of the distance from Deptford. They had the 10,000 volts there and 2,400 at the stations in London, and from these high pressure stations the electricity was distributed by transformers in parallel, as under the system in the specification.

Do you know whether this system was received at once in 1885 as a system that was satisfactory?

WITNESS replied that it took some time. The transformers attracted some notice at the Inventions Exhibition; but he himself did not pay attention to it until 1887. It was now used for half, or perhaps more than half, the electric lights in use in this country. He had carefully read the documents referred to in the particulars of objections in this case, and he did not find the invention described in this specification in any of the earlier publications. He considered that the specification gave sufficient instructions to enable the invention to be carried out. He did not know what further instructions could be given.

Q.: It is alleged that the knowledge which existed at the time was such that no invention was required to arrive at this invention?

WITNESS replied that the knowledge of transformers at the time was practically *nil*. There was no state of knowledge; there was a state of ignorance. But since 1886 there had been an enormous jump in knowledge of the whole subject.

Cross-examined by Mr. FLETCHER MOULTON, WITNESS said that ever since 1878, or, at least, before 1881, the question of electrical distribution had been before the public.

Mr. FLETCHER MOULTON: It was so prominently before the public that legislation took place with regard to it as early as 1882.

WITNESS: Yes; the first Electric Lighting Act, and there were a large number of companies formed for the purpose of distributing electricity on a large scale.

Mr. FLETCHER MOULTON: By electrical distribution was meant supplying to the public at their houses electrical energy?

WITNESS: Yes.

Mr. FLETCHER MOULTON: And the common way of doing it was just as we supply gas and water to individual houses.

WITNESS: That is so, in a qualified sense.

Mr. FLETCHER MOULTON, referring to Section 18 of the Electric Lighting Act of 1882, said that the form of distribution therein recognised was the parallel system of distribution.

WITNESS assented, adding that in the parallel system of distribution there were two mains, which ran side by side throughout the town, and in each of the consumers' houses there was a metallic pipe, called a pole, connected therewith.

Mr. FLETCHER MOULTON: And the company's work ended at those poles, and its duty was to keep the one pole with an electric pressure higher than the other.

WITNESS: Yes. I do not remember for the moment whether the Electric Light Act contemplated parallel distribution.

Mr. Fletcher Moulton: And the customer drew off the electric energy from those poles by strangling the machine, and what that machine was anybody had a right to prescribe?

Witness: No, I think not.

Mr. Fletcher Moulton: I had a right to use it for one machine and my neighbour for the same kind of machine.

Witness: Yes.

Mr. Fletcher Moulton then called attention to the manner in which that was provided for in the Provisional Orders of 1883, and explained to the Court that he was cross-examining the witness on the state of public knowledge. He wished to show that this was a claim for something which was perfectly well known before. It was a particular claim for drawing off electrical energy by transformers. The parallel system was a system under which the electricity used by each consumer was drawn off from a double series of mains; and in the provisional order it was referred to as the positive and negative poles.

In further cross-examination, Witness said that the two poles in a consumer's house were the substitute for a machine for producing electricity with constant tension.

Mr. Fletcher Moulton: In other words, the consumer, instead of starting his own little machine, had an equivalent to his machine in these two poles?

Witness: Yes.

Mr. Fletcher Moulton: Anything which could be done by a machine of constant tension could be done in the consumer's house by a substitute for a machine?

Witness: Oh, yes.

Mr. Fletcher Moulton: That was public knowledge in the eyes of the whole world?

Witness: Certainly.

Mr. Fletcher Moulton: Then when I am considering the state of public knowledge at that time, I am considering the two poles at the man's house as being, to all intents and purposes, an electrical machine?

Witness: Yes; anything with regard to constant potential work.

Mr. Fletcher Moulton: Suppose we take the position of a consumer then. It was not novel to work an induction coil or transformers by machines?

Witness: Oh, no.

Mr. Fletcher Moulton: Therefore, it was not novel to work transformers by the poles in a man's house?

Witness: I think it was, because there were no poles in a man's house.

Mr. Fletcher Moulton: Do you tell his Lordship that it was novel to put an induction coil on to a machine?

Witness: No.

Mr. Fletcher Moulton: It had to be worked by a machine?

Witness: Yes.

Mr. Fletcher Moulton: And what novelty would there be in putting an induction coil on to the poles in a house?

Witness: There is nothing to prevent it.

Mr. Fletcher Moulton: I put it to you that there was no novelty in it?

Witness: The poles are there, the equivalent to the machine for constant pressure.

Mr. Fletcher Moulton: There was no novelty.

His Lordship: As I understand Mr. Swinburne, he says there is no novelty in it, but that he never knew it to be done.

The Court then adjourned for the day.

The hearing was continued on Wednesday and Thursday. Our report of the evidence will appear next week.

(*To be continued.*)

Turner & Sons *v.* Brinsmead.

The hearing of this case was resumed on Tuesday, and continued on Wednesday, a number of experts giving evidence, but our report has to be held over until next week.

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—The affairs of John C. Liardet, 16, Hyde Park Gate, Kensington Road, W., and Cowley, Middlesex, came before Mr. Registrar Brougham on the 19th inst. with relation to the scheme of arrangement that has been accepted by the creditors. The debtor has been experimenting with and developing certain marine, electrical, and hydraulic patents, for the purpose of which he had works at Cowley. He failed in January, 1899, with assets valued at £19,000, and proofs of debt to the aggregate of £13,254 had been made against his estate. The failure was attributed by the debtor to his inability to realise his patents to advantage in time to meet pressing engagements. Upon the case being called, Mr. Ringwood, on the debtor's behalf, stated that the scheme of arrangement accepted by the creditors provided for at least a cash composition of 7s. 6d. in the £. Since they resolved to entertain the schemes, some of the largest creditors had held an informal meeting, and had decided to take shares (to the amount of 2½s. in the £ on their debts) in a new company in which the debtor was concerned. Under those circumstances he was instructed to ask for leave to withdraw the present scheme in order that a new meeting of the creditors might be called to consider the new terms. His Honour said the only scheme with which he had to deal that day was the one before the Court, and as it was not to be proceeded with it would simply be struck out of the list. It was his opinion, however, that a scheme which provided for a cash composition of at least 7s. 6d. in the £ was preferable to one dealing only with shares in a new company, and the debtor would be well advised to find the money as originally proposed. The application was then struck out.

On February 6th, at the London Bankruptcy Court, an application for discharge by E. M. Winter, electrical engineer, Amberley House, London, will be heard.

F. Gimblett, New Inn Chambers, Wych Street, W.C., has been appointed trustee in *re* F. B. de Foe Paynter, electrical engineer, of Catford.

Notice is given of release of trustee (W. M. Richards) in *re* F. Marson (F. Marson & Co.), electrician and ironmonger, Leicester.

Liquidations, Dissolutions, &c.—Messrs. E. F. Browning and F. L. L. Lindsay (Lindsay & Browning, electrical and mechanical engineers, Bangor) have dissolved partnership. Mr. Lindsay will attend to debts, and will continue the business.

A petition has been presented by creditors for the winding up of Messrs. Beaman & Deas, Limited, and will be heard before Mr. Justice Wright on January 31st.

Meeting of Creditors.—At the offices of Messrs. Armitage, Lyllies & Hinchcliffe, solicitors, Huddersfield, on 22nd inst., a meeting of the creditors of Messrs. Mitchell & Schofield, electric lighting engineers, Brockholes, was held. The liabilities amount to £696 14s. 10d., and the assets to about £440. It was resolved that the debtors should execute a deed of assignment to Mr. T. H. B. Tate, accountant, Huddersfield, as trustee, and three creditors were appointed as a committee of inspection.

Books Received.—"American Telephone Practice," by Kempster B. Miller. New York: American Electrician Company.

"The Yorkshire College, Leeds, Twenty-fifth Annual Report," 1898-9. Leeds: McCorquodale & Co., Limited.

"Laboratory Note Book" by V. B. Lewes and J. S. S. Brame. Westminster: Archibald Constable & Co. 4s.

"Export Merchant Shippers of Great Britain and Ireland," 1900. London: Dean & Son, Limited. 17s. 6d.

The Copper Market during the First Half of January.—Messrs. H. R. Merton & Company's statistical circular relating to the supplies and deliveries of copper during the first half of the present month shows that stocks have been reduced by 782 tons, and that the price of standard copper has advanced 10s. per ton. The total supplies have been 11,305 tons, but the total deliveries have been 11,737 tons, and in addition 350 tons of standard copper has been shipped from English ports to New York. On January 15th the stocks were therefore equal to 22,035 tons as compared with 22,817 tons on December 31st, and the price of G.M.Bs. was £70 10s. against £70 fifteen days earlier.

Electric Driving.—Electric generating plant is being put down at the Old Park Works, Wednesbury, belonging to the Patent Shaft and Axletree Company, as a substitute for steam as the motive power.

Electrical Engineering in Italy.—La Società Italiana per lo Struttamento del l'Energia Elettrica, of Milan, has made application to the Ticino Canton authorities for a concession to utilise the water-power of the River Maggia. It is estimated that 2,800 H.P. will be available.

Felten & Guilleaume.—Messrs. Felten & Guilleaume, of Carlswerk, in Mülheim, notify that they have transformed their business (excluding the branches in Vienna and Buda-Pesth, which will be worked as hitherto) into a limited liability company, styled "Felten & Guilleaume Carlswerk Actien Gesellschaft." The management of the company will be in the hands of Messrs. Th. Guilleaume, Max. Guilleaume and Herr A. Heiliger, of Cologne. Herr Emil Guilleaume is general director of the new company, and the other directors are Herren L. A. Roosen-Runge, C. Steven, J. M. Kemp, L. Bohnen, C. von der Herberg and Fr. Schleifenbaum.

For Sale.—In our advertisements this week will be found particulars of the steam and electrical plant of the Birmingham Carbide Company, Limited (in liquidation), which is being offered for sale by private contract by the liquidator.

Messrs. Wood & Newland are to sell by auction, on February 7th, the plant, machinery, &c., at the works of Heath, Snoxell & Co., Limited (in liquidation), Birmingham. See advertisement pages this week.

Gear-Cutting Machinery.—Messrs. Broadbent, Evill and Co., Town Chambers, Brown Street, Manchester, send us a pamphlet describing their automatic worm and bevel wheel-cutting machines. The apparatus, invented by Mr. J. H. Gibson, a draughtsman at Messrs. Lairds, of Birkenhead, was first put on the market by Messrs. Gibson & Sheffield, to whose business the present firm has succeeded. The principal point in this machine is that the cutting is effected by a single rotating tool which describes a correct helical path, while the blank is rotated independently by suitable change gear. In the past a cutting worm or "hob" served the double purpose. A similarly happy device is employed in cutting bevel wheels, much reducing the cost of manufacture, while gaining in mechanical and mathematical accuracy. The pamphlet is fully illustrated and is well worth perusal, and will be sent on application. Messrs. Broadbent, Evill & Co., are at present supplying cut wheels cut by their machines, or they will cut customers' own blanks.

Homes for Discharged Soldiers.—Mr. Edwin O. Sachs, as chairman of the Executive of the Building Trades' Gift to the Nation, writing from 1, Waterloo Place, Pall Mall, wishes to state in answer to the numerous inquiries from all parts of the country with which the executive have not yet been able to deal individually, that printed details are now being prepared, giving the exact quantities of materials, fittings, &c., required for the Discharged Soldiers' Homes. Mr. Sachs announces the names of the first donors who have generously contributed to the entire set of the six homes, irrespective of the quantity of materials required. The list includes:—Messrs. Strode & Co., the electric fittings for one house; the Conduit Insulation Company, electric conduits.

The Lancashire Electric Power Bill.—An influential meeting of representatives of Lancashire Municipal Corporations was held on Tuesday afternoon at Manchester, in opposition to the passing of the Lancashire Electric Power Bill, 1900. The promoters of the Bill are seeking authority to supply electric power to towns and districts in Lancashire south of the River Ribble, and including Preston. These towns comprise Liverpool, Manchester, Salford, Accrington, Blackburn, Bolton, Burnley, Oldham, Rochdale, St. Helens, Stockport, Warrington, and Wigan. "On behalf of all these towns it is strenuously urged that the Bill (we quote from a circular distributed in the meeting) should not be allowed to pass the second reading on the following grounds of public policy:—

(1) That, where Parliament has authorised a municipal corporation to borrow money for a municipal undertaking on the security of the rates, and the corporation has established their undertaking, special Parliamentary powers ought not, in the interest of the community, to be granted to a company trading for profit to execute works of a similar character within the borough, or to enter into competition with the Corporation without the consent of the Council of the borough. (2) That special Parliamentary powers to break up the streets ought not to be granted to a company trading for profit without the sanction of the community expressed through the Council. (3) That the Bill proposes to effect a practical repeal of the general law, on the faith of which millions of pounds throughout the kingdom have been borrowed by local authorities on credit of the rates. The Electric Lighting Acts make special provision with regard to the consent of the local authority for the express purpose of protecting local authorities, and it is submitted that such provisions ought not to be overridden to the extent proposed by the Bill for the benefit of a company trading for profit. (4) Parliament has already expressed a decisive opinion upon enterprises of a similar character by the rejection of the General Power Distributing Company's Bill on the second reading in the House of Commons on March 3rd, 1899. Powers similar to those sought by the present Bill were also refused by Parliament in the case of the County of London and Brush Provincial Electric Lighting Bill in the session of 1899. (5) It is proposed by the Bill to incorporate a company for the purpose of supplying electrical energy for lighting and power purposes in large areas, with power to break up or cause to be broken up public streets, and to occupy space therein without the consent of the local authority, and without any compensation in respect thereof."

It is further stated that the consent of the local authorities affected has not been obtained. It is submitted that a company trading for profit ought not, for its own benefit, to be allowed by a private Act to override, to such a drastic extent, general legislation enacted for the protection of local authorities. In addition to the general grounds already referred to, in which it is urged that this Bill ought not to pass second reading, it is further submitted that practical considerations do not show the likelihood of any possible substantial advantage, either in the shape of more rapid development of electrical undertakings, or of cheaper supply, but on the contrary. The municipal corporations entirely dispute the pretensions of the companies that they can supply electricity at a lower price than the Corporations themselves. As against any possible saving there may be in cheaper land, or in carriage of coal and concentration of machinery, there must be set off the extra cost of mains to convey the power, the cost and waste of power in transforming the energy for use, and the excessive dividend to be paid by the company as compared with interest at 3 per cent. by a corporation. Moreover, the area of a large borough forms the most desirable unit for area of supply, as providing all the elements favourable to a good average demand, and the cost of distribution of power in any borough certainly cannot be done more cheaply by a company than by a Corporation. It is submitted that the facts justify no such retrograde step in the principles of local self-government as is suggested in this Bill. During the last 50 years the policy of legislation has been to encourage and foster the assumption by municipal authorities of duties in which the community are interested. The departure from this policy—by a private Bill—justifies, it is confidently urged, the exceptional course of opposition to and rejection of the Bill on second reading.

The Lord Mayor of Manchester (Mr. Thomas Briggs) presided, and representatives from all, or nearly all, the towns affected were present.

Mr. Alderman Higginbottom (Manchester) read the following resolution:—

That this Conference of Municipal Corporations within the area comprised in the Lancashire Electric Power Bill, 1900, protests against the same as contravening the principle for which municipal corporations have in past years successfully contended, and which have been established by the Tramways Act, 1870, and the Electric Lighting Acts of 1882 and 1888, and determine to take united action in opposition to the Bill.

This was unanimously passed.

It was also resolved:—

That an executive committee be appointed from the towns present at this conference for the purpose of giving effect to the foregoing resolutions, and for conducting an opposition to all stages of the Lancashire Electric Power Bill. That such executive committee be authorised and requested to apportion the expenses in regard to this matter among the various corporations comprised in the conference. That the executive committee be authorised to consider the provisions of similar Bills on the subject affecting other parts of the kingdom, and to co-operate in reference thereto to such extent as they may think desirable, and also to take part in any conference or conferences which may be held in reference to any electricity Bills promoted in Parliament in the present session. That the executive committee be authorised to add to their number.

The Metropolitan Supply Company Fined.—At the Marylebone Police Court last Friday, the Metropolitan Electric Supply Company, Limited, were summoned by Mr. J. W. Godfrey, on behalf of the London County Council, for having, on various dates in October and November last, failed to supply electric energy to the premises of Sir Felix Semon, physician, of 39, Wimpole Street; Mr. H. T. Butlin, consulting surgeon, of 82, Harley Street; and Mr. Alfred Arthur Hudson, barrister, of 28, Weymouth Street. Mr. Daldy appeared for the prosecution, and Mr. Muir for the defence. Mr. Daldy stated that the Council had received many complaints of the company having failed in their contract to provide a continuous supply of electric energy for the use of their customers, and that the persons named in the summons were representative of the bulk. The company, on a previous occasion, had pleaded as an excuse for their default that difficulties in connection with the construction of their new works at Willesden had occurred over which they had no control; but he (counsel) put it that the company had undertaken new business which they were unable to execute except at the expense and inconvenience of their other customers, and to the benefit of the company. This failing of the light had proved a very serious matter. He maintained that the company could have no answer to these complaints, for they were compelled by statutory obligations to keep their contracts with their customers.—Mr. Hudson and Mrs. Butlin both gave evidence of the supply of electricity being stopped for varying periods on different dates, on one or more occasions as long as six hours.—Mr. Muir, for the defence, denied that the company had extended their operations at the expense of their other customers. The failure had arisen from other causes. The learned counsel then narrated the nature of many difficulties which had had to be overcome in connection with the erection of works at Willesden—difficulties which no amount of human foresight could anticipate, and which the company had no power to prevent. Since December 15th last the supply had been constant, and measures had been adopted whereby it would be impossible for failures to recur in the future. He called Mr. E. Cunliffe Owen, the secretary, and Mr. Todd, the chief engineer of the company, who bore out the statement. Ample provision, they said, had been made for the future. Mr. Curtis Bennett said it was clear that the company had done its best under very difficult circumstances, but, nevertheless, they had not complied with the conditions under which they had obtained their very extensive powers from Parliament, and they were, therefore, liable to a penalty. He gave the company credit for having done their best, but they had failed in their obligations. The company would be fined 10s., with 23s. costs on each of the six summonses; total, £9 18s.

North Metropolitan Electric Power.—A Bill has been deposited for next session to incorporate a company by the name of the North Metropolitan Electric Supply Company, for the purpose of supplying "electrical energy in bulk" within the districts of the Poor Law Unions of Hendon, Barnet, Edmonton, Ware, Hertford, Hatfield, Welwyn and St. Albans, and within the parishes of Chingford and Walthamstow. The capital of the company is to be £270,000 divided into 27,000 shares of £10 each, and with the right to raise, by the issue of debenture stock, a further sum of £90,000. For the purposes of the company it is proposed to erect two generating stations, one at Edmonton and the other at Hertford. The promoters named in this Bill are the same as those mentioned in the County of Durham Electric Power Supply Bill.

The Paris Exhibition.—Messrs. Witting Brothers, Limited (Electricité and Hydraulique, Société Anonyme), write as follows:—

With reference to a note that recently appeared in your columns regarding the supply of current for power and lighting in the future Paris Exhibition, we do not find the name of our works appearing in the list you give of the electrical contractors. We would like to point out that they are putting down two three-phase sets, each of 1,200 H.P., for the above Exhibition, the current generated by these sets being distributed in the Exhibition and grounds by over 80 three-phase transformers. In addition to this there will be installed about 600 H.P. of direct-current plant, making a total of 3,000 H.P. or 2,240 KW. You will thus see that our works are by far the largest electrical contractors for the Exhibition, when compared with those mentioned in the note in question.

Our note was quoted, as then stated, from the *Shipping World*.

Private Bills.—The Examiners of Standing Order proofs at their sitting on 19th inst. ordered the following to be reported to Parliament for first reading, viz.: the North Metropolitan Electric Power Supply Bill. The case of the County of London and Brush Provincial Electric Lighting Company Bill, which was postponed on the previous day, was also dealt with, compliance with Standing Orders being reported.

Sentence.—At the South London Sessions last week, before Mr. M'Connell, Q.C., chairman, A. W. Longman, 28, clerk, pleaded guilty to embezzling £194 belonging to his employers, Messrs. Elliott Bros., of Lewisham, electrical instrument makers. The chairman sentenced him to six months' imprisonment in the second division.

Shannon Electric Power Scheme.—The Inspectors of Irish Fisheries have arranged to hold inquiries at Limerick, Killaloe, and Athlone, into the probable effects of the works to be carried out by the Shannon Water and Electric Power Company, in the fisheries of the river Shannon. A memorial complaining that the preliminary Standing Orders have not been complied with, has been deposited on behalf of Mr. E. T. Fagham. The Limerick city engineer has reported against the works being allowed to interfere with the city water supply from the source at Doonas, which the scheme might possibly affect.

South Wales Electrical Power Scheme.—Last week a conference was held between the representatives of the Glamorgan County Council and the Cardiff Corporation with reference to this Bill, the idea being that the two bodies might jointly oppose the Bill.

The War.—We have quite a batch of notices this week showing the lively interest which electrical engineers are taking in the South African war. First in importance is the announcement that the services of 150 of Major Crompton's electrical volunteers have been accepted by the War Office, and that £3,000 is to be allowed for the provision of apparatus for their use at the front. The electrical fraternity, as a whole, will have a hearty cheer to raise for their self-sacrificing *confrères* who have so loyally come forward to render what service they can to their Queen and country; one and all will wish them God speed and a safe and early return. This remark does not apply to Major Crompton's party alone, but to the many electrical assistants at municipal works, and electrical manufactories, and showrooms throughout the country, who are already on their way out to take part in active fighting if by hook or crook a chance occurs. Every week new names are coming to our notice of young men who have thrown in their lot with Lord Roberts to quell this revolt. The send-off given to them by their fellow-workers has been of the heartiest, and their positions are being kept open for them when they return.

The "Britannia" *remarque* proof of the photogravure "Sons of the Empire," after the original, by Harry Payne, which we have received from Messrs. Raphael Tuck & Sons, Limited, is a work which will be in great demand during the next few weeks. The proofs are now ready for issue to the public, and prints will be obtainable next week. The picture represents a unique spectacle of the "Sons of the Empire" standing shoulder to shoulder in the cause of justice and freedom, the Colonies hastening to share the dangers and participate in the glories of the Mother Country. Some of our Continental "friends" seem to have entertained a notion that the first reverse received by the British arms in South Africa would result in a desire on the part of all our other Colonies to sever their connection with us altogether. That the effect of our misfortunes has been of an entirely opposite kind, bringing about an unparalleled outburst of patriotic enthusiasm and remarkable offers of assistance in money, men, and kind throughout the whole British Empire, has disappointed these "friends," and the probabilities are that by the time this affair is at an end this country will be respected by the whole world instead of appearing to stand in a position of "splendid isolation." Our colonies and the dear homeland are knit closer than ever they were because of this untoward circumstance, and as feeling is running very high here just at present, we have no doubt that "Sons of the Empire" will have such a large sale that the first year's profits (which Messrs. Raphael Tuck intend devoting to the "Mansion House" and *Daily Telegraph* Transvaal War Funds) will amount to a considerable sum. We are asked to say that there are for sale 250 double *remarque* proofs offered at £5 5s. each, 500 single ditto at £3 3s., 1,000 artist's proofs at £1, and an unlimited number of prints on plate paper at 5s. We are convinced that any of our readers who purchase one of these proofs will be very pleased with it.

We understand that Mr. M. W. Holmes (with the firm of Borland and Co., electricians, Leeds) is going to the front. He has been presented by his fellow-workers with a handsome silver cigarette case. He goes as dispenser in connection with the Ambulance Department.

The Mr. Harry Woolhouse referred to in our issue of January 19th under the heading "Electrical Engineers for the Front," is now said to have been with the General Electric Company, Limited, and not the National Telephone Company, as then stated.

A good deal is being written about the telegraph rates to South Africa at the present moment. "An ex-M.P." writes to the *Times* complaining of "the extortionate rates charged for telegraphic communication with our sick, wounded, and dying soldiers in South Africa." Whilst in every direction great pecuniary sacrifices are being made to assist the vigorous prosecution of the war, whilst many firms and individuals are giving half pay to the wives and families of the Reservists, "The Eastern Telegraph Company," the writer observes, "is exacting remorselessly its pound of flesh from the relatives and friends of every sufferer at the front without the abatement of a single farthing from its oppressive charges." "Only a few days ago," he adds, "I met on the steps of the Eastern Telegraph Company a poor soldier who had sent a message of 12 words to the seat of war which cost him £2 8s., equal to nearly seven weeks of his pay."

The Marquis of Tweeddale, chairman of the Eastern Telegraph Company, writes, in regard to this, as follows:—

> With reference to the complaint of an ex-M.P. as to the alleged excessive charges of the Eastern Telegraph Company for telegraphic communication with sick, wounded, and dying soldiers in South Africa and their relatives in this country, I beg to say, on behalf of the board, that it would be obviously impossible for the company to transmit all such messages free of charge; but the cables are, and have been since the commencement of operations, transmitting such messages free, subject to the signature of the same by a responsible official of the War Office, whose decision as to the reasonable character of the request for free transmission the company accepts.
>
> All inquirers at the company's office are, consequently, in the first instance, referred to that official, whose signature at once ensures the despatch of any such message without charge.

An officer of the Royal Engineers, Telegraph Battalion, in a letter from De Aar, says:—"Marconi's installations are pottering about, but haven't done anything yet. The installations are all under Marconi's civilians, who seem to be all either Finsbury or Central men, *i.e.*, men from the City and Guilds Technical Institute. . . . . The Wheatstone automatic has worked beautifully."

The *Times* says that the third contingent of the 24th Middlesex (Post Office) Rifle Volunteers, belonging to the Telegraph Reserve of the Royal Engineers, together with a draft of Regular Reservists of the same battalion, embarked on Saturday at the Royal Albert Docks in the transport *St. Andrew* for South Africa. The detachment numbered 60, and brings the total representation of the 24th Middlesex with the South African force up to 480 men. The commanding officer of the 24th Middlesex has been authorised by the Secretary for War to increase the strength by an addition of 50 men of the company of his regiment which supplies the First-Class Army Reserves to the 1st Telegraph Battalion, Royal Engineers.

Water Softening.—We read in a brewing contemporary that the business of the "Reeves" Patent Filters Company, Limited, London, has been acquired by Messrs. Mather & Platt, Limited, of Salford Iron Works, Manchester, and will in future be carried on at that address, in conjunction with their softening and purifying business, by the well-known "Archbutt-Deely" process. The services of Mr. Reeves and the whole of his staff have been retained.

ELECTRIC LIGHTING NOTES.

Abercarn.—The District Council will oppose the South Wales Electrical Power Company's Bill.

Alfreton.—A meeting of the General Purposes Committee of the Alfreton Urban District Council, which consists of the whole of the members, has been held to consider the report of the Alfreton Ward members in regard to the public lighting in the town. A vote of the ratepayers was recently taken as to whether they were in favour of the electric light or the purchase of the Alfreton gas works. A large majority decided in favour of the electric light. It was therefore resolved to take steps to obtain the requisite legal powers.

Basingstoke.—The Town Council has resolved to apply to the Board of Trade for a provisional order for the supply of electricity in the borough.

Bexhill.—On Thursday last week Col. A. G. Durnford, R.E., a Local Government Board inspector, conducted an inquiry into an application by the District Council for powers to borrow £5,000 in connection with the electric lighting scheme.

Bridgwater.—The Lighting Committee having recommended that the Town Council should instruct Mr. Trentham to prepare plans and specifications for electricity works, the Council, after some discussion, decided to call a town's meeting on the subject.

Brighouse.—The Brighouse Corporation is negotiating with the Halifax Corporation with a view to obtaining a supply of electricity from the latter in preference to one from the existing plant at Brighouse.

Canterbury.—The electric light accounts for the three-quarters of a year since the installation shows the net profits to be just under £200. The £1,500 allowed, therefore, in the estimates for any deficiency will not be required for that purpose, and the Town Council is to be congratulated upon the success of the undertaking.

Chatham.—On the 23rd inst. the Town Hall was opened by Lord Rosebery in the presence of the Mayors of Kent and many local celebrities. The building is illuminated throughout by electricity, the whole of the work having been carried out to the specifications of Mr. John Hewett, of Messrs. Harrap, Hewett & Duffield, consulting electrical engineers to the Corporation. The wiring is drawn into a watertight system of iron barrel, suitable draw boxes being provided, and there being no soldered joints whatever in the building. Distribution boards are arranged for every department, to which the circuits are run direct from the main switchboard in the entrance hall. There are altogether 312 16-C.P. and two 50-C.P. incandescent lamps, and three 8-ampere arcs. The whole of the switchboards are arranged to open at the back, the frame supporting the marble being hinged to a shallow iron box built into the wall, into which the whole of the barrels containing the cables are brought. The whole of the barrels are under the plaster, and this arrangement permits of easy access to the back of any board at any time by merely unlocking. The contractors for the work were:—Wiring, Messrs. Stevens & Barker, of Maidstone; fittings, the Edison & Swan United Electric Light Company; switchboards, Messrs. Hodges & Todd, Limited, under a sub-contract to Messrs. Stevens & Barker. A complete installation of telephones on the inter-communication system has been carried out by Messrs. Chard & Co., of Great Portland Street, W., connecting the Council Chamber with the Mayor's Parlour and the whole of the borough officials' offices.

Chichester.—After a prolonged discussion, the City Council has decided to postpone the question of electric lighting. It was proposed to use electro-motors for pumping water and sewage, obtaining power from the electricity works; since this would constitute a heavy load, which could be handled in conjunction with the lighting in such a way as to keep a nearly constant load on the generators day and night, the arrangement would undoubtedly have been a most economical one, and success would have been assured from the start, while a very low price per unit could have been charged to consumers. It is to be hoped, therefore, that in their own interests the Council will reconsider the matter.

Croydon.—The Council is now inviting tenders for extending the buildings at the Corporation electric light station.

Deptford.—On Thursday last week a meeting of users of electric light in New Cross and Deptford was held at the Goldsmiths' Institute, New Cross, to consider what steps should be taken to improve the supply of electricity in the district. Mr. Sidney Webb, L.C.C., presided. Mr. J. S. Redmayne, secretary of the Goldsmiths'

Institute, said that he had called the meeting at the request of several of the chief consumers of the electric light in the district. Tests had been taken in the Institute, which showed that the pressure fluctuated from 100 to 75 volts. He believed the Board of Trade made a stipulation that companies must not give less than four below 100 volts—anything below 96 was bad lighting. Several gentlemen having expressed very strongly their dissatisfaction with the way in which they were supplied, the chairman said that the London County Council had no power in the matter. Some Vestries had taken the subject under their own control, and were supplying customers with electricity. Wherever companies were supplying electricity they were making default in so doing. The explanation was due, he had no doubt, to the fact that their business had increased so fast during the past year that it was altogether beyond their power to cope with it. But in spite of that they were going on booking customers. Vestries or District Boards had the power to proceed against any company for every default made, and in view of that he would suggest that the Greenwich Board be asked to institute proceedings against the company on absolute evidence of default. He would also suggest that every customer deduct 25 per cent from his electric lighting bill, and ask the company to sue for it. He did not think, however, they would do so. A resolution was carried unanimously, urging on the Greenwich District Board the desirability of taking legal proceedings against the London Electric Supply Corporation for the statutory penalties for default of supply, and it was further resolved unanimously that all consumers who have suffered from default be recommended to deduct not less than 25 per cent. from their quarter's bills, and to inform the company of the reason. A committee was formed to carry on the agitation for better light and take such steps as may be possible for the defence of the consumers.

Dufftown.—The Police Commissioners have appointed a committee to inquire into the question of electric lighting, which has been raised by a firm of electrical engineers.

Glasgow.—The Electricity Committee proposes to spend £50,000, with the view of extending the city electrical plant. Up till now more than half-a-million of money has been spent, or authorised to be spent, for this purpose, the total expenditure authorised by Act of Parliament being £700,000.

Govan.—The electricity supply was formally commenced on the 13th inst.; the system adopted is the low pressure three-wire at 500 volts, and 85 arc lamps have been erected for street lighting. The capital outlay has amounted to £25,000.

Jarrow and Hebburn.—The Walker and Wallsend Union Gas Company has deposited a Bill for next session to extend its powers to supply electricity within the borough of Jarrow and the urban district of Hebburn. By this company's Act of 1899 powers to supply electricity were granted within the urban districts of Wallsend and Willington Quay and the parish of Willington, and it is believed by the company that an extension of these powers to Jarrow and Hebburn will not materially add to the initial cost of generating the supply. The Bill does not, therefore, propose the erection of any additional generating station, but, for the purposes "of their electricity undertaking," it is proposed to raise £250,000 additional ordinary capital and £62,500 of further debenture stock. Power is also sought by the company to enter into agreements to supply electricity in bulk to the Corporation of Jarrow, the Hebburn Urban District Council, and the Newcastle-upon-Tyne Electric Supply Company, Limited.

Leeds.—Since the Leeds Corporation purchased the business of the Yorkshire House-to-House Electricity Company, Limited, about a year ago, says the *Yorkshire Post*, it has been its aim to extend the works in such a way as to adequately meet the growing needs of the city. For the purpose of ascertaining the best means of at once improving the mode of supply and the extension of the premises in Whitehall Road, the Committee having charge of the electric lighting of the city instructed Messrs. Hopkinson and Talbot, their electrical engineers, to draw up a report. This report, which has just been prepared, divides itself into three heads—finance, the provision of power in the area at present occupied by the Corporation mains, and the extension of electric supply into other districts. On the question of finance it has been decided to postpone a decision until there has been an opportunity of obtaining the Lord Mayor's advice, and that of other financial experts. With regard to the provision of power in the area at present covered by the Corporation's mains, it has been decided to recommend that the Corporation should not introduce any other system of supply into that area, and that, seeing the great improvements that have been made in single-phase motors, the Corporation should provide for hire motors of this type, which, though suffering some disadvantages in comparison with motors on other systems, are capable of providing power for those who require it. In reference to the question of the future extension of the works, it has been agreed to ask the Council to at once proceed to develop the Britannia Mills site, and to provide plant and machinery for producing currents on the two-phase system at 50 periods per second, as suggested by Messrs. Hopkinson and Talbot. The Britannia Mills, which adjoin the electric lighting works, were taken over by the Corporation from the House-to-House Electricity Company at the time of purchase. The price was £217,420, paid in 5 per cent. irredeemable stock. The cost of the extension now proposed is roughly calculated at about £100,000. Copies of the specialists' report are to be forwarded to the members of the Council, and its adoption in the form indicated will be recommended at the next meeting.

The Corporation is making arrangements for the lighting of all the public thoroughfares in the centre of the city by electricity.

Leith.—Owing to a short circuit in a junction box, the electricity supply to parts of the town failed for a few hours on Saturday evening last week. The damage was quickly rectified.

Liverpool.—At a meeting of the Electric Power and Lighting Committee last week it was stated that permission had been received from the Local Government Board for the borrowing of £300,000 for the construction of electric generating works at Newsham Park and elsewhere, and for the development of the electric lighting undertaking.

London.—In compliance with the obligation which was last year placed upon the Charing Cross and Strand Electricity Supply Corporation by Parliament with reference to its supply to the City of London, a Bill has now been deposited to provide a separate generating station for the purposes of the corporation's undertaking "within a period of two years" from the passing of the City of London Provisional Order Act of 1899. The site of the new generating station will be situate in West Ham, and will be connected with the company's existing stations in the parishes of St. Giles and St. Martin-in-the-Fields. The company is taking this opportunity to obtain powers "to sell electricity in bulk" to any local authority desiring a supply in bulk and having themselves powers of distributive supply.

The Lighting Committee of the Hampstead Vestry has reported that the top load at the station during the past year was on December 23rd, and amounted to 1,198 KW., against 917 KW. in the year 1898; that the total output of units generated during the 12 months ended December 31st, 1899, was 1,548,018, against 1,083,667 for the year 1898, or an increase, approximately, of 50 per cent.; and that the total number of lamps connected on December 31st was equivalent to 100,451 8-C.P., against 78,091 on the corresponding date in 1898, being an increase of 28 per cent.

Marylebone.—At a meeting of the members of the St. Marylebone Vestry on Thursday last week, Mr. Brooke-Hitchings presiding, Mr. John Lewis drew attention to the deputation which had waited upon the President of the Board of Trade on the previous day. He thought that the President of the Board of Trade was in favour of a competing electric supply company, by means of which the complaints as to defective lighting would be remedied. He hoped that the Vestry would see the advisability of applying for a provisional order to supply electric lighting in the parish. He moved that the Vestry clerk should write to the President of the Board of Trade stating that, while objecting to a second company, the parish was itself most anxious to have powers for generating electric lighting, and that it intended to apply for a provisional order. Several members thought that this was too important a question to be discussed without notice, and the chairman ruled that, objection having been taken, notice must be given.

Newcastle.—At a meeting of the Newcastle Town Improvement Committee last week, the town clerk intimated that an application would be made to the next session of Parliament by the Tyneside Electric Power Company for a Bill to give them powers for the business of electric supply. The company, it was stated, intended to supply a large number of villages and small towns on Tyneside with electricity for lighting and other purposes. The company would seek, therefore, amongst other things, power to carry mains through the streets of Newcastle, and that would entail considerable inconvenience to the public. The committee therefore decided, in the event of the Parliamentary and Bye Laws Committee also being of the same opinion, that the town clerk be instructed to take the necessary steps to protect the rights of the citizens in the matter, and to oppose the Bill.

Oban.—The Town Council assembled last week for the purpose of resolving to apply to the Board of Trade for a license to supply electricity, but was disconcerted to find that the Board no longer grants licenses! As it is too late to apply for a provisional order in the present session of Parliament, Oban must wait until next year.

Rugby.—The Urban District Council has endeavoured to ascertain the number of consumers likely to use electric light by issuing a circular, in which, amongst other things, it is stated that the cost of installation is 50s. per lamp. The reason given for this excessively high estimate is that the schools were wired at this rate. It would be well if the Council were acquainted with the fact that shops, &c., can be efficiently wired and fitted complete for little more than half this figure.

St. Helens (I.O.W.).—The District Council has approved of the provisional order proposed by Messrs. Roberts & Co., subject to the introduction of a clause giving the Council power to purchase after 14 years at a price equal to the capital expended plus 15 per cent. on the same.

Seaham (Durham).—The Council are considering whether they should decline to give consent to the application of the County of Durham Electrical Power Distribution Company for a provisional order for the district and undertake the supply of electricity themselves. They have appointed Mr. F. J. Warden-Stevens to advise on the matter.

Sheerness.—The Town Council on Tuesday last approved of the draft provisional order applied for by the Power Distribution Company. The arrangements of the terms of purchase, should the Council eventually decide to acquire the undertaking, are to be settled by agreement.

(Continued on page 147.)

LEICESTER CORPORATION ELECTRICITY WORKS.

The illustrations which we give this week show that, in spite of the difficulties encountered in the early days of the undertaking, the Leicester Corporation is in possession of a generating station of the first rank, with up-to-date machinery and appliances, while the fact that the capacity of the works is to be immediately more than doubled is sufficient proof that the financial results have been equally satisfactory.

As we gave a full description of the works, as originally laid out in 1895, in our issue for April 26th of that year, we need not recapitulate the details of the engines, which are practically unaltered, with the exception that the smaller one of the four at first installed has been replaced by one of the same size as the rest.

The alternators, however, have been entirely removed and replaced by Ganz machines. It will be remembered that the original Mordey alternators, of 200 KW. each, would not run in parallel satisfactorily, and that the Brush Company undertook to substitute for them inductor alternators, which they were then commencing to build. As, however, the company could not supply machines of its own make in the time specified, it was decided to import Ganz alternators—a course which, at the time, called forth some strong comments.

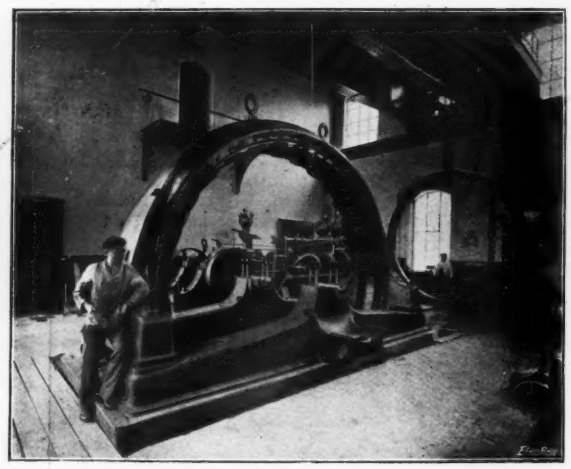
The new machines are shown in course of construction in the figures on pp. 144 and 146. It will be seen that the exciting coil is entirely self-contained, being wound on a T-shaped cast-iron ring; the latter is supported at intervals by brackets, which are bolted to the frame of the stator. The armature core consists of soft iron lamin æ, which are supported by a heavy cast-iron frame; this is divided in a horizontal plane, and the core plates, which elsewhere break joint, are here cut through, so that the upper half of the stator can be lifted off if necessary.

The armature conductors are threaded through tunnels, of which the roofs are slit; the holes are bushed with micanite tubes, which are capable of resisting a pressure of 30,000 volts.

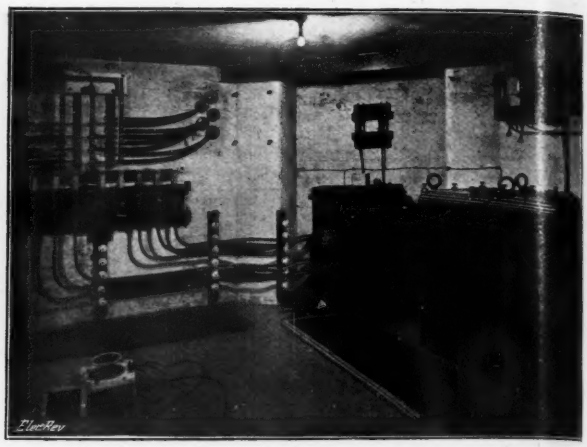
General View of Engine Room.

The rotor consists of a steel ring carried on a cast-iron spider, with hollow spokes cast in one piece with the hub; a circular feather is turned on each side of the rim of the wheel, fitting into corresponding recesses in the inductors. Each of the latter is secured by a single tap bolt passing through the rim, and the successive inductors are staggered, so that those of opposite polarity act on different armature coils. It will be seen that the machines are in principle

identical with those manufactured by the Brush Electrical Engineering Company, under the same (Mr. Mordey's) patents; they were, in fact, supplied through the Brush Company.



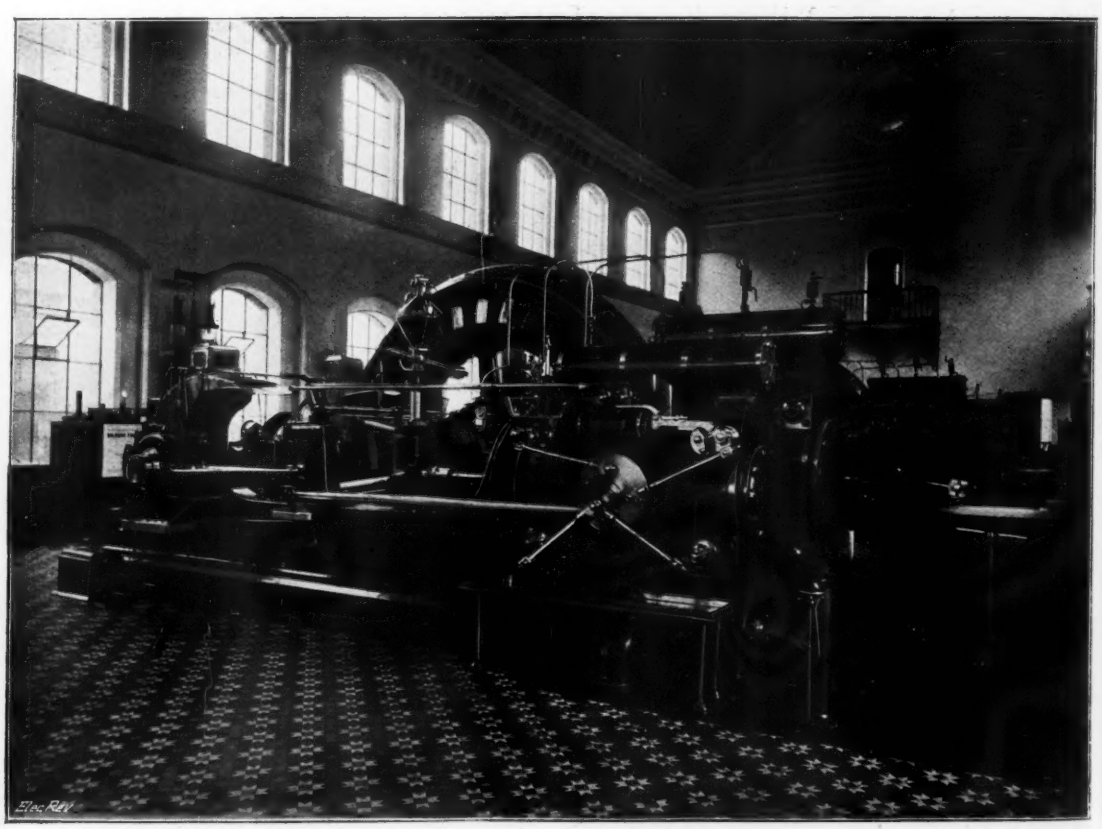
400-kw. Alternator; Armature, and Exciting Coil.



Low Pressure Fuseboard and Transformers at Gas Offices.

The exciter of each alternator is mounted on an extension of the main shaft, and is of the 6-pole drum-wound type, with four sets of carbon brushes.

driving them. This fact indicates, of course, that the engines were far too powerful for their work when coupled to the old alternators. Their most economical load is about 340 kw. The frequency, which used to be 100 periods per sec., was lowered when the above alterations were made, to 50 per second—an improvement which has led to the adoption of a considerable number of motors in the city. The



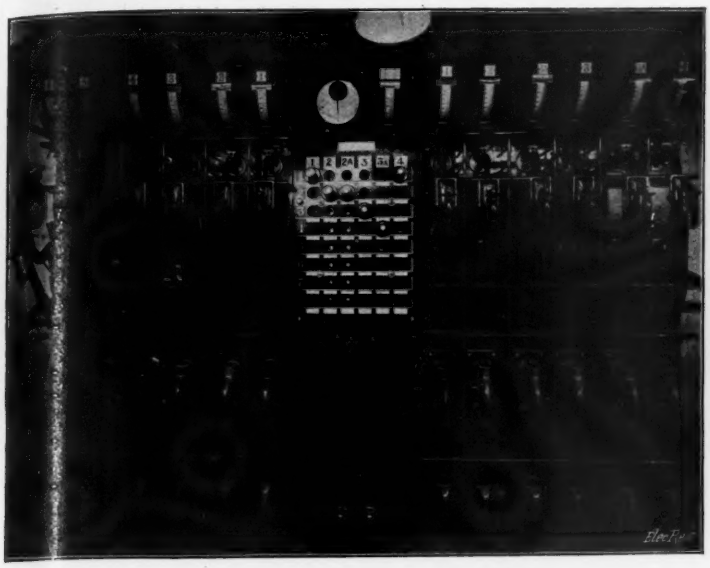
View of Engine, High Pressure Side.

The normal output of the new machines, 200 amperes at 2,200 volts, or, say, 400 kw., is double that of those originally supplied; the engines, however—which were built by Messrs. Hick, Hargreaves & Co.—are fully capable of exciting current varies from 100 to 120 amperes, at 50 to 60 volts.

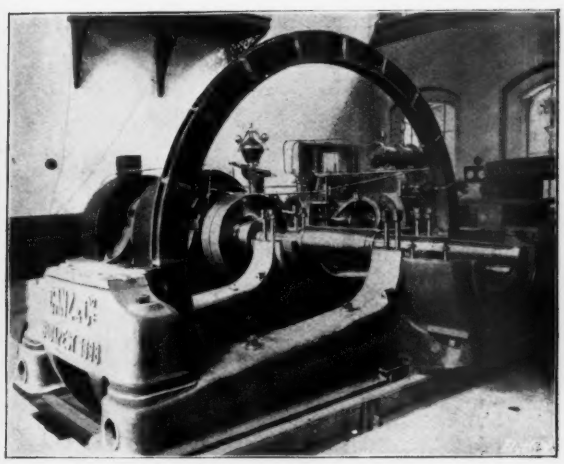
The alternators are still run on separate circuits, change-over switches being fixed near them by means of which

any circuit can be quickly thrown on any machine; but parallel running will of necessity be adopted when the extensions now contemplated are completed. The latter involve the erection of a new engine room, 140 feet long, 55 feet wide, and 40 feet high, and a boiler room 140 feet × 71 feet. The new generating plant will consist of two 1,000-KW. Brush inductor alternators, driven at 100 revolutions per minute by horizontal compound condensing engines of Messrs. Hick, Hargreaves & Co.'s make; the alternator will be placed between the high and low pressure lines. Space will be available for two other sets of the same size for future extensions.

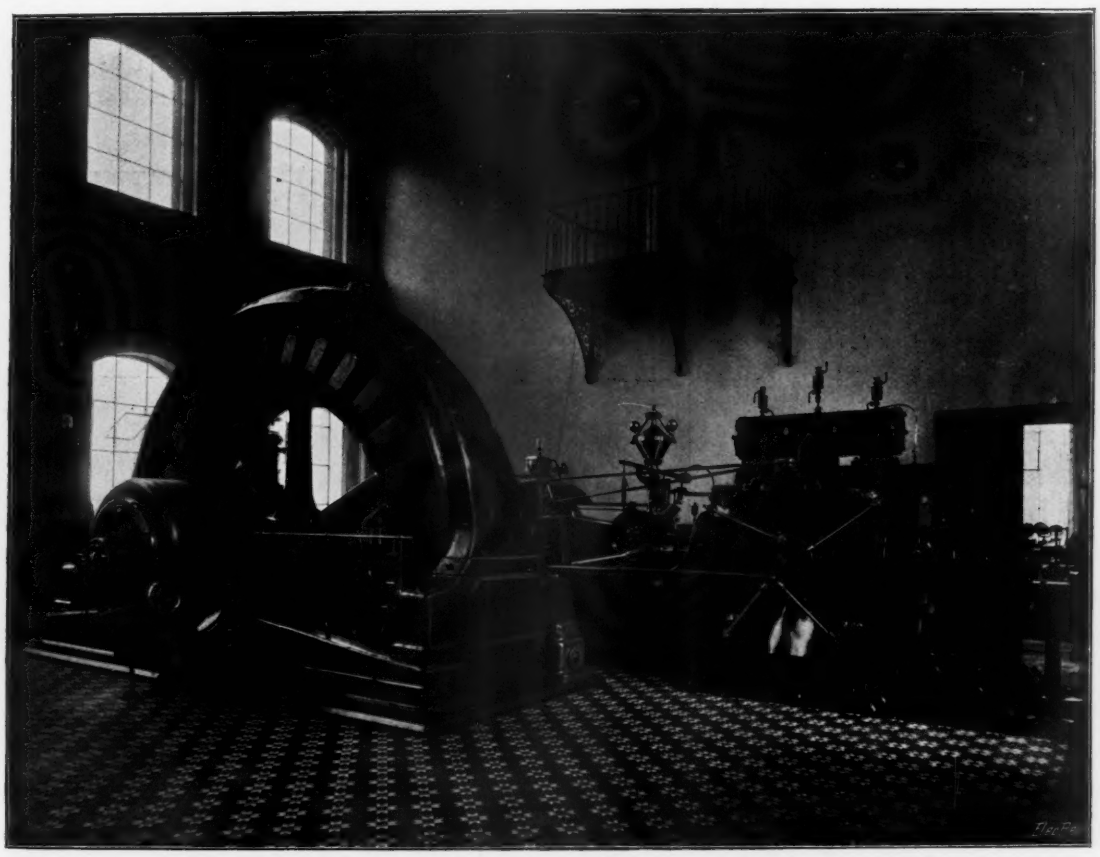
Five Lancashire boilers of 500 H.P. each are to be added, with space for five more; the latter will be over the Saffron brook, which will be bridged over for the purpose. A new stack will also be built, 200 or 220 feet high, and a Green's economiser will be erected. The old engine room will be connected with the new one by a switch room, from which the whole of the works will be controlled, and the Raworth switch pillars at present in use will be dispensed with.



Distributing Switchboard at Gas Offices.

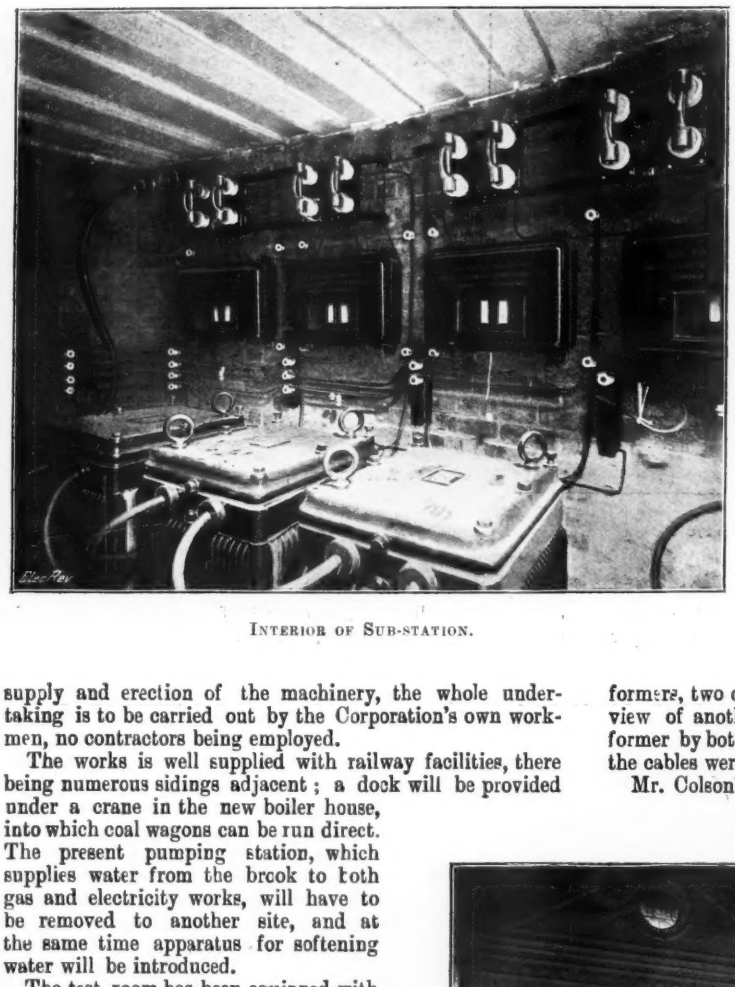


400-KW. Alternator; Exciting Coil and Shaft in Place.



View of Steam Alternator and Exciter.

Mr. Alfred Colson, engineer and manager of both the gas and the electricity undertakings, hopes to have the new plant in operation in time for the winter of 1900-1, in which event a remarkably quick piece of work will have been accomplished. It should be noted that, apart from the supply and erection of the machinery, the whole undertaking is to be carried out by the Corporation's own workmen, no contractors being employed.



Interior of Sub-station.

The works is well supplied with railway facilities, there being numerous sidings adjacent; a dock will be provided under a crane in the new boiler house, into which coal wagons can be run direct. The present pumping station, which supplies water from the brook to both gas and electricity works, will have to be removed to another site, and at the same time apparatus for softening water will be introduced.

The test room has been equipped with three Kelvin balances, reading up to 100 and 200 amperes, and 10 KW., and with a Kelvin multicellular voltmeter reading to 120 volts; an Ayrton-Mather galvanometer and a Lithanode testing battery are also provided. A number of Aron meters of the latest pattern were in the test room at the time of our visit, and we were informed that they were being extensively adopted.

An important distributing station in the basement of the gas offices has recently been fitted with a new switchboard, of which we give a view. The left-hand panel is intended for the control of six trunk mains from the generating station, which supply electricity in bulk to the sub-station. The ammeters are of Messrs. Nalder Bros. and Thompson's edge-wise pattern, each reading to 200 amperes; the main switches and fuses were made by the Brush Company, which supplied the whole outfit.

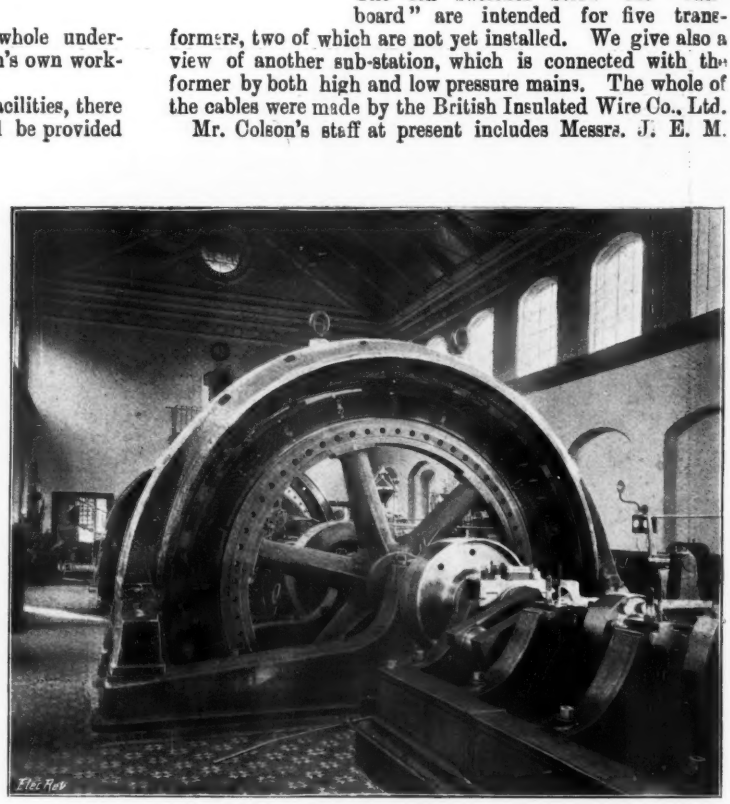
The former are very heavy, and are intended to be operated with both hands; each is provided with a brake which prevents recoil, and a rubber buffer to prevent mechanical shock. The switch itself consists of a massive curved copper bar, the ends of which are forced into heavy spring contacts; in the act of opening the switch a metal guard is released, which covers the lower part of the ammeter and prevents injury to the latter by arcing. The trunk mains are of the concentric type, with the outer earthed at the works; the switch gear is therefore on the inner only, but disconnecting pieces in circuit with the outer are provided at the bottom of the board for testing purposes.

The right-hand panel provides for six high pressure feeders, two of which can be looped if desired, and is similar to the "trunk" panel.

The centre panel carries horizontal bus bars for the trunk mains, and vertical bars for the feeders, so that any feeder can be plugged on any main. An Ayrton-Mather electrostatic voltmeter, and an ammeter in series with the outer, which can be short-circuited by the bridging piece, seen below, complete the equipment.

The apparatus is mounted on a handsome slate base supported by wrought-iron posts, and is situated in a room of ample size. An adjoining chamber contains three 36-KW. Brush transformers, and a low pressure "fuseboard," consisting of two gun-metal bars, 1½ inches square in cross section, supported on insulators. The outer of each cable, of which there are eight, is clamped to the ∩-shaped bar seen in our illustration, and the inner is connected with the straight bar through a copper fuse wire, the whole forming an arrangement of ideal simplicity. The ten switches below the "fuseboard" are intended for five transformers, two of which are not yet installed. We give also a view of another sub-station, which is connected with the former by both high and low pressure mains. The whole of the cables were made by the British Insulated Wire Co., Ltd.

Mr. Colson's staff at present includes Messrs. J. E. M. Stewart, chief assistant; G. and A. Charlton and W. E. Barton, in charge of the works; and T. Roles, mains superintendent. We have to thank Mr. Colson for affording us facilities for preparing this article, and Mr. Stewart for the willing assistance which he gave towards it.



400-KW. Alternator; Armature, Exciting Coil, and Rotor without Inductors.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 142.)

South Wales.—The Bill promoted by the South Wales Electric Power Distribution Company will be opposed by the Pontypridd District Council, which intends applying for its own provisional order; the Caerphilly District Council has decided not to oppose the Bill.

Spain.—A company has just been formed in Santander, with a capital of £80,000, with the title La Sociedad Electra del Besaya, to supply electric energy for lighting and power purposes in that town. The power plant will be located 55 kilometres from Santander, at a point where the power of the River Besaya is to be utilised.

Thirsk.—The Thirsk Parish Council has resolved to appeal to the Board of Trade against the application of the electric lighting company for a provisional order, on the ground that the undertakers have not obtained the consent of the Council, and that they propose to lay mains in a small number of streets only.

Tonbridge.—The week before last we received from Mr. Medhurst a local paper containing a report of the Council meeting at which the appointment of consulting engineer was discussed. Upon this report we framed the note which appeared in our last issue, in the course of which we ventured to remark that the affair did "not bring credit to the electrical profession as a whole, or to the gentlemen affected in particular." We had also received from Mr. Medhurst copies of the correspondence which passed between himself and Mr. Hammond, with a request that we would publish it in full, but this we said that we could not do without first obtaining Mr. Hammond's consent. Mr. Medhurst afterwards requested us not to publish it, as he was bringing the letters before the attention of the Institution of Electrical Engineers. As we anticipated last week, however, Mr. Hammond has something to say. He writes to us that he read the words quoted above with astonishment, as "I could not have exercised greater care than I did to avoid acting unprofessionally." He adds that he can only suppose that the writer of the paragraph was unaware of the real facts, which he requests us to make known in our current issue; we, therefore, think it advisable, all things considered, that the correspondence as received by us from Mr. Medhurst, should be printed in full, so that our readers may form their own opinions of the affair. We are sorry to have upset Mr. Hammond's feelings, which we certainly had no intention of doing, but as our remarks were made from the local report of the proceedings, and not from the correspondence, we possibly gathered a wrong impression of what had been going on with regard to the Tonbridge lighting. If words have any meaning, Mr. Hammond seems to us to have acted within his rights, for there are, of course, numerous cases in which councils have secured reports from more than one engineer, and if the Tonbridge Council were not satisfied with one report, surely it is no reflection upon another engineer for them to seek his services in the shape of getting a second report. Moreover, in the *Tonbridge Free Press* of Dec. 9th last, the report of the Electric Lighting Committee is quoted, and the Council is recommended to approach Mr. Robert Hammond, of London, to ascertain the terms on which he would be prepared to act as consulting electrical engineer. We find no mention of Mr. Medhurst's name in the Committee's report. But let the correspondence speak for itself:—

13, Victoria Street, S.W.,
May 29th, 1899.

R. Hammond, Esq.

Dear Sir,—I see in the technical papers that you have been giving a lecture on electrical matters at Tonbridge.

You are probably aware that the Urban District Council of Tonbridge employed me to make a report to them on the electric lighting of the town some 2½ years ago.

May I ask whether your lecture was given with the object of getting yourself retained to carry out an electric lighting scheme for Tonbridge, or whether it was given merely with a view of popularising the subject, so that the scheme prepared by me for the Council might be carried out?

I may say that Mr. W. H. Preece, not so very long ago, lectured at Bangor on the electric lighting of that town, mainly, I believe, with the object of overcoming local opposition to my scheme—and certainly with no ulterior object of obtaining any work or appointment for himself or his son.

I shall be much obliged to you if you will be good enough to let me have a reply to my question, and

I am, yours truly,
(Signed) F. H. Medhurst.

[copy.]

64, Victoria Street, Westminster,
May 30th, 1899.

F. Hastings Medhurst, Esq.,
13, Victoria Street, S.W.

Dear Sir,—I am in receipt of yours of yesterday's date, and beg to advise you that before accepting the invitation of the Tonbridge Ratepayers' Association to deliver a lecture to them on electric lighting, I was careful to ascertain whether they had any professional adviser, and was assured that they had not.

I note, however, that in virtue of work done by you for the Council there 2½ years since, you consider you have a claim to be appointed to carry out their undertaking.

I certainly did not give the lecture for the purpose of depriving you or anyone else of a piece of work.

Yours faithfully,
(Signed) Robert Hammond.

[copy]

13, Victoria Street, S.W.,
May 31st, 1899.

Robert Hammond, Esq.,
64, Victoria Street, S.W.

Dear Sir,—I thank you for your yesterday's letter.

I note you say that you were careful to ascertain before accepting the invitation of the Tonbridge Ratepayers' Association to deliver a lecture that they had no professional adviser; but have you ever heard of any Ratepayers' Association that has had an electrical adviser in the sense of having retained a consulting electrical engineer?

I take it that the only thing that the Tonbridge Ratepayers' Association could do in this direction would be to have some sort of report, or lecture, presented to them; but, of course, it would not be competent for them to engage a professional man to carry out an electric lighting scheme, because no Ratepayers' Association has any power to do anything of the kind.

Do you not yourself consider that when one engineer has been employed to make a report to a Town Council, his relations should not be disturbed by the intervention of any other consulting engineer, unless the second engineer has reason to believe that the first engineer's scheme has been rejected, and he himself dismissed?

Tonbridge simply presents the usual case of a report having been obtained by the Town Council with a view to enabling the Council to decide whether it will, or will not go in for a provisional order, and of course it is probably accurate enough to say that unless you, or some other consulting engineer tried to come between the Council and myself, it would in all probability never occur to a single member of it to engage any other consulting engineer than myself for carrying out the work when they decide to do so.

Would you mind letting me know definitely, and categorically, whether you intend, directly or indirectly, to apply for the appointment of consulting engineer to the Tonbridge Urban District Council, or whether, in the event of the Council offering you the appointment, under the circumstances you would accept it?

I am, yours faithfully,
(Signed) F. H. Medhurst.

[copy.]

64, Victoria Street, Westminster,
June 1st, 1899.

F. Hastings Medhurst, Esq.,
13, Victoria Street, S.W.

Dear Sir,—I am sorry that I have put you to the trouble of writing me a second letter through the slipshod use in my last of the pronoun "they" instead of the words:—

"Urban District Council of Tonbridge."

I am of the distinct opinion that you are wrong in your impression of the attitude of that Council towards yourself, otherwise the invitation to move the matter a stage further would certainly have been addressed to you.

I know of no right on your part to ask me the categorical questions with which you close your letter.

Yours faithfully,
(Signed) Robert Hammond.

[copy.]

13, Victoria Street, S.W.,
June 2nd, 1899.

Robert Hammond, Esq.

Dear Sir,—I am obliged to you for your yesterday's letter, the contents of which rather surprise me, for I was under the impression that since your election as a member of the Council of the Institution of Electrical Engineers, you would have shown some little regard for the usual observances and amenities of professional life.

Of course, I knew that before your election as a member of the Council, you were not in the habit of considering much beyond your own personal advantage in seeking for professional work. At Bath you knew that the Corporation had consulted me, yet you had no hesitation in obtaining, by the most assiduous personal canvassing of the members of the Corporation, the actual appointment for carrying out the work for yourself. Still, this happened years ago, and as I said before, I was under the impression that your election as a member of the Council of the Institution, to which we both belong, would have made some little difference in your methods.

You say in your letter that I am wrong in my impression of the attitude of the Tonbridge Urban District Council towards myself, because the Tonbridge Ratepayers' Association and not the Council invited you to give them (the Ratepayers' Association) a lecture.

I can scarcely imagine a greater *non sequitur*.

My only right to ask you the categorical questions with which I closed my last letter is the right of a man whose professional business is being interfered with in a manner which appears to me, at all events, to be as dishonourable as it is happily unusual.

Yours faithfully,
(Signed) F. H. Medhurst.

Copy of letter sent to the clerk relating to correspondence between Mr. Medhurst and Mr. Hammond.

December 28th, 1899.

A. H. Neve, Esq., jun.
Clerk to the Urban District Council,
Tonbridge.

Dear Sir,—I see in the press that the Electric Lighting Committee of your Council recommend that Mr. Robert Hammond be approached to ascertain the terms on which he would be willing to act as consulting engineer.

I therefore beg to forward the enclosed copy of correspondence which has passed between Mr. Hammond and myself, and, as the matter is one of considerable importance to both local authorities and engineers, I trust that you will bring the correspondence before your Council at its next meeting.

I am, dear Sir, yours faithfully,
(Signed) F. H. Medhurst.

Just as we are going to press a letter from Bath informs us that in January, 1895, Mr Medhurst was invited to meet the Lighting Committee before the Committee came to any decision upon the question as to who they should appoint as electrical engineer to advise them; and it was expressly stipulated that the Committee was only pledged to the payment of a fee of 5 guineas for the interview. This stipulation was accepted, and Mr. Medhurst met the Committee on January 7th, after which, his fee was paid and no instructions were given to him to act in any way for the Corporation. Some time afterwards, Mr. Hammond was invited to meet the Committee, and received instructions to represent and advise the Corporation, which he has done to the present time.

Witney.—The Electric Lighting Committee of the District Council reported that they had considered the draft provisional order of the Witney Electric Supply Company, and had approved it, with slight alteration. Their report was adopted.

Woking.—The Urban District Council has approved of a number of amendments to the proposed provisional order of the Woking Electric Supply Company, Limited, which have been recommended by the Electric Light Committee, and the company will be requested to settle the clauses accordingly.

York.—Although the municipal electricity works have not yet commenced supply, we understand that over 6,000 8-c.p. lamps have been applied for. This is purely for lighting load. Further extensions of mains are being contemplated. Mr. C. A. Midgley is the city electrical engineer.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—We are pleased to give publication to the following communication from Mr. J. Alex. Bell, city electrical engineer:—"I find in your issue of January 19th, under 'Electric Traction Notes,' that you state that on Monday last (the 15th inst.) the electric car service was brought to a standstill through a defect in an underground feeder; and also that on the 9th inst. a tramcar collided with a timber wagon and was thrown off the rails. These notes, which are evidently taken from the local newspapers, do not represent the true state of affairs, and I shall be glad if you can see your way to make a correction of the same in your next issue. With reference to the failure on the 14th, this was not due to an underground feeder; it occurred about half an hour before the usual stopping time of the service, and resulted in keeping the three last cars on the line till the fault was found and remedied. The real fault was the failure of the cable in the trolley pole of one of the cars. With reference to the collision of the 9th inst., the tramcar was not thrown off the rails, but the driver, previous to the collision, had locked his wheel with a handbrake, which was damaged by striking the lorry, and it was necessary to disconnect the brake gear before the wheels could be again released. This caused some slight delay, and naturally blocked the traffic for a short time.—J. Alex. Bell."

Bradford.—It is stated that the Corporation are negotiating for the purchase of unexpired leases of 25 miles of tramways now held by two local companies. The Corporation already own six miles of electric tramways. Before laying down the rails the Corporation ordered 100 new trolley cars, because of the long time required for delivery.

Two electric cars collided near the points on the Bolton Road section last week. Both platforms were smashed, the 40 passengers shaken up, and the line blocked for two hours.

Constantinople.—A Berlin syndicate, it is stated, is about to send a delegate to Constantinople to petition the Ministers of Commerce and Public Works for a concession for an electric tramway at Constantinople.

Croydon.—The County Council Electricity Committee have considered a report prepared by the borough electrical engineer with regard to the extension of the buildings and plant in connection with the supply of current to the tramways, mains extensions for lighting supply, &c. They recommended that the works provided for in the following estimates be carried out, that the sanction of the Local Government Board be sought to a loan of £50,550, and that if such sanction be granted it be referred to the Finance Committee to raise the necessary loan:—Direct current plant for tramways, extension to engine room, boiler house, and pump room, £5,000; foundations, £1,595; boilers, £4,280; economiser, £640; cooling tower, £980; hot well, £50; feed water heater, £1,000; traveller (rails extensions), £620; extras and contingencies, £1,000; alternating current plant, £6,800; for house service and transformers, £10,000; total, £50,550. The report was adopted by the Council last week.

Dublin.—The secretary of the Tramways Company says that further investigation has shown that the stoppage in the electric tram service on 11th inst. was caused not by any intrinsic defect in the pumps at the Ringsend power station, but was the result of failure of the water supply to same, owing to a choked pipe before the alternative water supply was completed.

The last great auction of tram horses for the Dublin United Tramway Company will be held on Thursday, 1st prox. By that time the two sections of the tram system now worked by horse haulage will be worked electrically.

Electric traction has now been introduced on the tramway line between Hatch Street and Westland Row, and the cars run on to Kingsbridge.

Dudley.—The erection of the municipal generating station at Dudley for supplying the tramways and for providing electric lighting is now proceeding rapidly. It was proposed to work a refuse destructor in connection with the generating plant—to utilise the calorific power of the burning refuse for generating steam—but the cost was found to be prohibitive. Our local correspondent says that the electric tramway from Dudley to Stourbridge is working fairly satisfactorily, but the cars are not large enough, and great complaints of overcrowding are continually made. A large number of larger cars are on order from a Chicago firm. Dudley is spending over £40,000, Mr. R. P. Wilson, of London, being the consulting engineer.

Dumbarton.—The Town Council has given its approval to the Bill of the Glasgow District Tramways Company.

Lancaster.—The Corporation Bill which includes electric tramway and other powers, has been approved by a town's meeting.

Liverpool.—The new Cabbage Hall and Castle Street electric tram service, *vid* Everton Valley, was inaugurated on 22nd inst.

Manchester.—The Corporation Waterworks Committee has been considering the effect of electricity on water mains, and considers that the danger will be greatly increased by the electric tramways. As a result of a recent debate, it was resolved to request the Technical Instruction Committee to permit a series of experiments at their school with a view to ascertaining definitely how far these anticipations of damage to the underground property of the Waterworks Department are warranted.

The Metropolitan Railway Electric Traction Experiments.—In the course of their report to the shareholders the directors of the Metropolitan Railway Company say:—"The engineer, Sir J. Wolfe Barry, K.C.B., reports that preliminary experiments in connection with electric traction have been carried out jointly by this company and the District Company on the section of line between Earl's Court and High Street, Kensington, and that so far they have proved successful. Trial trips with the experimental train have been run, and a further exhaustive series of tests is now being made."

The Bill which has been deposited for next session by the Metropolitan District Railway Company is divided into seven parts. Part 1 contains only interpretation clauses. Part 2 confers further powers on the company to work by electricity certain railways owned or used by them. For this purpose it is proposed to erect a generating station near Lot's Road, Chelsea, and to lay cables from the generating station, under the bed of Chelsea Creek, and along the West London Extension Railway, to the railway of the company at West Brompton and Earl's Court stations. Power is also sought to abstract water from Chelsea Creek for the purposes of condensing steam in connection with the generating station. By Part 3 the company ask for permissive power to "work by electrical power the traffic on their existing railways, or any of them or any part thereof, and on the City lines and extension railways of the company and the Metropolitan Company, and on any railways of the Metropolitan Company which the company are authorised or empowered to run over, work, or use." It is, however, provided that these powers shall in no way prejudice the right of the Metropolitan Company to run over the Inner Circle Railway, or make such running powers "less easy and convenient," nor shall these powers be exercised over any part of the railways of the Metropolitan Company without their previous consent. Provision is also made to enable the company, the Metropolitan Company, and the Brompton and Piccadilly Circus Railway Company to enter into agreements for the mutual supply of electricity one to the other. Under Part 4 an agreement is confirmed for the transfer of the undertaking of the Ealing and South Harrow Company to the District Company. Part 5 empowers the company to apply to the purposes of this Act any moneys which they are already authorised to raise, but no additional capital is authorised. By Part 6 an extension of time is sought until August, 1902, within which to acquire the necessary lands required for the construction of the Brompton and Piccadilly Circus Railway as authorised in 1897,

and until August, 1904, within which to complete this railway. By Part 7 the company seek power "to convey merchandise traffic" on the railways of the Hounslow and Metropolitan Railway Company.

Sheffield.—The Tramways Committee intends making a trial of a new system of surface-contact tramway, invented by Mr. Wm. Aldred, of Sheffield.

Southport.—The Bill of the Southport and Lytham Tramroad Company, for constructing a tramway across the Ribble, which has just been deposited in Parliament, is really a reconstruction of the portions of the same company's Bill which were rejected by a House of Lords' Committee last year at the instance of the Preston Corporation. The preamble recites that "it would be to the public and local advantage if the company were authorised to construct the tramroads, tramway, and bridge in this Act described" so as to make direct means of communication between Southport and Lytham across the estuary of the Ribble. This is described as consisting of five tramways. The first is to be over 3¼ miles long, and connects the already authorised line with a point near the sands in the township of Hesketh-with-Becconsall. Thence the line proceeds across the sands for 7 furlongs 4·10 chains on a pier with open ironwork supports. Thence a conveyer bridge would carry the tramcars across the trained channel of the River Ribble, suspended in a carriage of steel travelling on ropes of steel. The estimated cost of the works is given as £183,500, of which £53,154 is put down for the conveyer bridge.

Work has been commenced upon the electric trams scheme, and standards to carry the overhead wires are being erected.

Tunbridge Wells.—On Wednesday last week, the Electricity Committee, accompanied by the Deputy Town Clerk and Mr. Horace Boot, the electrical engineer, visited Dover for the purpose of inspecting the Corporation tramways. They were shown over the electricity works, the car sheds, and the route, by the general manager. The majority of them think it essential that tramways should be introduced at Tunbridge Wells.

Walsall.—A special meeting of the Town Council on Monday unanimously confirmed the decision to purchase the tramways within the borough, approving the agreement with the company concerned in them, and authorising the town clerk to apply for the sanction of the Board of Trade. The Mayor next proposed that the Council confirm the decision to promote a Corporation Bill, for the extension of the tramways and for other purposes in the ensuing Session of Parliament. In the course of a few observations, his Worship said he regretted that the Urban District Councils of Handsworth and Perry Barr had signified their intention of opposing the Walsall Corporation Bill. Some of them seemed to have come to the conclusion that it was not desirable that tramways should pass through those districts. He could not help but think, and he thought the whole of the Council would draw the same conclusion also, that it was a short-sighted policy on the part of Handsworth and Perry Barr, and they were not without hope that they would yet be able to get them to see the matter in the same light as Walsall. The Walsall Council had no desire to own the tramways in the Handsworth and Perry Barr districts, their only object was to get the powers, and they were of opinion that the suggested tramways would be much to the advantage of those living in the districts. They wanted to see a better tramway connection in the district, and they hoped that the sub-committee dealing with the matter would come to some satisfactory arrangement with the District Councils named. The Bill had satisfied the Examiner on Standing Orders, except with regard to the Perry Barr and Handsworth tramways, and in regard to these it was adjourned for further consideration.

Wolverhampton.—Our correspondent writes that, notwithstanding the fact that arrangements have been made by the Corporation to purchase the tramways in the borough, there is at the present time considerable activity shown by the company owning the lines to put them in good condition. Sir Fredk. Bramwell, as has been stated, is to hold a court to fix the amount of compensation to be paid to the company by the Corporation for taking over the tramways and the plant. Meanwhile, the employés of the company are busily engaged on various sections of the line throughout the borough putting the roadways in a thorough state of repair.

TELEGRAPH AND TELEPHONE NOTES.

The Cuba Submarine Telegraph Company's Claim.—A despatch from Washington says that President McKinley has sent to the Senate papers bearing on the claim of the Cuba Submarine Telegraph Company for £8,174 damages arising out of the war between the United States and Spain. The President recommends the payment of this sum as an act of comity and equity.

Huddersfield Telephones.—The area embraced by the suggested municipal telephone exchange is an extensive one, and includes the whole of the borough of Huddersfield, and the townships of Brighouse, part of Elland, Kirkheaton, Farnley Tyas, Skelmanthorpe, Honley, Holmfirth, Meltham, Millsbridge, Golcar, Slaithwaite, Marsden, and parts of Mirfield and Raventhorpe. The Tradesmen's Association is requesting the Council to proceed with the scheme.

Isle of Wight Telephone.—The Isle of Wight County Council is calling a meeting of representatives of the Island public authorities with a view to bringing about a reduction in the telephone charges.

The Pacific Scheme.—The *Times* Ottawa correspondent says that there is another burst of indignation in the Canadian press over the attitude of the Imperial authorities on the Pacific cable question. A vigorous protest is raised against farther concessions to the Eastern Telegraph Company or any other cause of obstruction and delay. Several newspapers urge Mr. Chamberlain to give the matter his personal attention and to abolish a disappointing obstruction. The Ottawa *Citizen*, in a vigorous article, says that the aims of the Colonies must not be frustrated by any official in Downing Street, however exalted his position.

Proposed New Cable to Germany.—The *Times* Berlin correspondent says that complaints have been rife regarding delay in the transmission of telegrams to England in consequence of the inadequacy of the existing cables. The Imperial Telegraphs Administration some weeks ago placed proposals before the British Post Office for laying a new cable between Emden and the English coast. The assent of the British authorities to these proposals has not yet been obtained.

Strike.—It is stated that about 100 of the men employed by the National Telephone Company at Liverpool struck work on 22nd inst., because of certain alterations which have been made in the conditions of employment in wet weather.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired
WEST INDIES:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1891 duplicate)	Oct. 23, 1899 ...	...
SOUTH AFRICAN:—		
Mozambique-Lourenço-Marques	Dec. 17, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Tarifa-Tangier	Jan. 3, 1900 ...	...
Iquique-Valparaiso	Jan. 10, 1900 ...	Jan. 19, 1900
Serena-Valparaiso	...	...
Landlines.		
WEST INDIES:—		
Communication with Les Cayes (Haiti)	Nov. 21, 1899 ...	...
SOUTH AFRICAN:—		
Communication with Mafeking and beyond	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication with north of Mooi River (Natal)	...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with Colombia ...	Nov. 3, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 10, 1899 ...	...
Communication with Saigon-Bangkok	Jan. 22, 1900 ...	Jan. 23, 1900
Communication with all towns of United States of Colombia beyond Buenaventura	Jan. 22, 1900 ...	...

Wireless Telegraphy.—The *Morning Post* Brussels correspondent telegraphs that "Signor Guarini, an Italian living in the Belgian capital, has, improving on Marconi's method, constructed an apparatus for wireless telegraphy over long distances. Signor Guarini, it is stated, intends to test his system between Brussels and London, and wireless telegraphic communication between London and New York is talked of as well within the range of probability as the result of this new invention. The inventor has also taken out patents for wireless telephonic communication."

CONTRACTS OPEN AND CLOSED.

OPEN.

Bath.—February 12th. The Corporation invites tenders for high and low tension cables, arc lamps and posts, transformers, and sub-station and main works' switchboards. See "Official Notices" January 19th.

Bedford.—February 6th. The Corporation wants tenders for a surface condenser with air and circulating pumps, and engine for driving same. See our "Official Notices" to-day.

Belfast.—February 8th. The Electric Committee wants tenders for 400-KW. steam dynamos. See our "Official Notices" January 5th.

Bootle.—February 17th. The Corporation wants tenders for underground electric cables. See "Official Notices" to-day.

Bradford.—February 3rd. The Tramways Committee is inviting tenders for the complete electrical overhead equipment of about eight miles of tramway. Specifications, &c., at the City Surveyor's office, Town Hall, on payment of £3.

Coatbridge.—The Town Council is anxious to receive proposals from companies willing to lay down electric tramways. See "Official Notices" this week.

Dudley.—February 8th. The Corporation wants tenders for pumps, feed water heaters, and pipe work for the electricity works. See "Official Notices" to-day.

France.—January 30th. Tenders are being invited until the 30th inst. by the French Minister of Posts and Telegraphs for the supply of 10,000 metres of iron pipes, 80 mm. diameter, for pneumatic pipe lines. Tenders to be sent to Le Fons-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Glasgow.—January 29th. The Corporation invites tenders for the supply and fitting up of a hydraulic or electric lift. Plans and specifications on application to Mr. Thomas Young, consulting engineer, 4, West Regent Street, on payment of a fee of £1 1s.

Glasgow.—February 5th. The Corporation wants tenders for two overhead electric travelling cranes for the tramway station. See "Official Notices" to-day.

Great Yarmouth.—February 15th. The Corporation wants tenders for two water-tube boilers and three 200-KW. continuous current steam dynamos. See "Official Notices" Jan. 19th.

Hastings.—February 12th. The Corporation wants tenders for 12 20-KW. alternating current transformers and sub-station switch gear. See "Official Notices" to-day.

Horsham.—March 1st. The Urban District Council is wanting tenders for water-tube boilers, pipework, two steam dynamos, batteries, switchboard, 6-ton overhead traveller, mains, road work, enclosed arcs, and station lighting. See "Official Notices" to-day.

Hull.—February 19th. The Corporation wants tenders for 35 double motor equipments and 10 car bodies. See "Official Notices" to-day.

Inverness.—February 8th. The Town Council wants tenders for two 200-KW. steam dynamos, fuel economiser, motor balancer and booster, battery, three water-tube boilers, overhead traveller, switchboards, station lighting, arc lamps, feeders and distributors, joint and service boxes and service cables, meters, tools, &c. See "Official Notices" to-day.

Keighley.—February 3rd. The Corporation wants tenders for two Lancashire boilers, mechanical stokers, economisers, feed pumps, one 120 and one 200-KW. high speed continuous current steam dynamos. See "Official Notices" January 19th.

Leyton.—February 14th. The Electric Lighting Committee wants tenders for a switchboard for the new electric light works. See "Official Notices" January 19th.

London.—February 5th. The Postmaster-General is inviting tenders for underground work, including laying conduits and pipes for telephone purposes in several parts of the metropolis. See "Official Notices" January 19th.

Melbourne.—March 1st. The Corporation is wanting tenders for boilers, engines, dynamos, switchboard, feeders, mains, arc light leads, accumulators, &c., for electric lighting. See "Official Notices" December 22nd.

Plymouth.—January 31st. The Corporation wants tenders for a 500-KW. steam dynamo (motor generators, &c.); a 500-KW. steam alternator, &c.; accumulators; Lancashire boilers and equipment; mains. See "Official Notices" January 5th.

Spain.—January 27th. The municipal authorities of Porcuna (Jaen province) are inviting tenders until the 27th inst., for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from El Secretario del Ayuntamiento de Porcuna (Jaen) to whom tenders are to be sent.

Stoke-upon-Trent.—February 13th. The Guardians want tenders for the electric lighting of a portion of the workhouse premises. See "Official Notices" January 19th.

Sunderland.—The Corporation wants tenders for a tramways switchboard. See "Official Notices" January 12th.

Tunbridge Wells.—February 5th. The Corporation wants tenders for the supply of two Lancashire boilers for the electricity works. See "Official Notices" January 19th.

Tynemouth.—January 31st. The Corporation wants tenders for 12 electricity meters. See "Official Notices" Jan. 19th.

York.—The Corporation invites tenders for the conversion of the wiring of the Courts of Justice to suit higher voltage. See "Official Notices" this week.

CLOSED.

Hammersmith.—The Vestry received tenders ranging from £125 to £199 18s., for installing electric light at Ravenscourt Park Public Library. The tender of Mr. Hellyar (the lowest) was accepted.

Harrow.—The Harrow Electric Light and Power Company, Limited, have accepted the tenders of Messrs. Mather & Platt, Limited, for 150-KW. multipolar dynamo and Willans engine, and for extension to switchboard.

Hull.—The following is a list of the tenders received for engines and dynamos:—

ENGINES—	
Chester & Co., Renfrew	£4,625
W. H. Allen, Son & Co., Bedford	4,670*
Willans & Robinson, Limited, Rugby	4,813
Belliss & Morcom, Limited, Birmingham	5,440
" " " "	5,611
DYNAMOS—	
Earles' Shipbuilding Company, Limited, Hull	3,795
Thomas Parker, Limited, Wolverhampton	5,035*
Electric Construction Company, Limited Wolverhampton	5,275
Crompton & Co., Limited, Chelmsford	6,313
COMBINED ENGINES AND DYNAMOS (not to specification)—	
C. A. Parsons & Co., Newcastle	8,722

Those marked * are recommended by the committee for acceptance. The various tenders were reported upon in detail by Mr. Barnard, city electrical engineer.

Leeds.—The Baths Committee has accepted the tender of Mr. E. Wallis for an installation of electric light in the Union Street baths.

West Bromwich.—On Monday the Electric Lighting Committee reported that they had been considering tenders for the supply of boilers, steam dynamos, condenser, feed-water heater, travelling crane, switchboard, cables, and storage battery, in connection with the electric lighting, and they recommended that the tender of Messrs. E. Danks & Co., Limited, for boilers; of Messrs. C. A. Parsons & Co. for steam dynamos, condenser, feed-water heater, and travelling crane; of Messrs. Cowans, Limited, for cables; of the Tudor Accumulator Company, Limited, for storage battery and connections, be accepted. The report was adopted by the Council.

West Ham.—The Town Council has accepted the following tenders for plant required in connection with the electricity undertaking:—Thames Ironworks and Shipbuilding Company (steam dynamos, switchboard, piping, &c.) £4 627; Hart Secondary Battery Company (accumulators) £681; Wheeler Condenser Company (cooling tower and condensing plant) £845; D. Bruce Peebles and Co. (electric motors) £547; Veritys (telephones) £135.

FORTHCOMING EVENTS.

Friday, January 26th.—At 5 p.m. Physical Society. 1. "Some Developments in the use of Price's Guard Wire in Insulation Tests." By Prof. Ayrton and Mr. Mather. 2. "Reflection and Transmission of Electric Waves along Wires." By Dr. E. Barton and Mr. L. Lownds. 3. "The Frequency of the Transverse Vibrations of a Stretched India-rubber Cord." By Mr. T. J. Barker.

At 8 p.m.—Electro-Harmonic Society's smoking concert (patriotic night), Café Monico, Regent Street, W. See "Notes" this week.

At 9 p.m.—Royal Institution. The Hon. C. A. Parsons on "Motive Power, High-Speed Navigation, Steam Turbines."

Saturday, January 27th.—Institution of Junior Engineers' Anniversary Dinner at Westminster Palace Hotel.

Wednesday, January 31st.—At 7 p.m. Institute of Marine Engineers. Eleventh annual conversazione and ball at Stratford Town Hall. At 7.15 a miscellaneous entertainment will be given in the Grand Hall, and will include organ solos by celebrated artists. An exhibition of lantern slides will be given by E. B. Caird, Esq. The ball is to commence 8.30 prompt. Messrs. William I. Taylor and W. C. Roberts are the joint conveners.

At 7.30 p.m. Institution of Electrical Engineers. Students' meeting. There will be a discussion on a "Comparison between Continuous Current and Alternate Current Motors."

Thursday, February 1st.—At 8 p.m. Röntgen Society, at 20, Hanover Square. Paper by Dr. Hugh Walsham, on "Röntgen Rays in Diseases of the Chest." Mr. A. Hastings Stewart, M.R.C.S.E., will show a small Egyptian Mummy and skiagrams of the same. On March 1st there will be a paper by Mr. J. H. Gardner, and on April 5th Dr. Norris Wolfenden and Dr. Forbes Ross will contribute one on "The Influence of the X Rays upon the Growth and Development of Micro-Organisms."

Friday, February 2nd.—Royal Institution. Mr. G. Marconi lectures on "Wireless Telegraphy."

Institution of Junior Engineers. Paper on "Arc Lamps and Arc Lighting," by H. G. Cotsworth.

At 2.30 p.m. Institution of Civil Engineers. Students' visit to the electrical works of the London United Tramways, Limited, Chiswick.

NOTES.

The Electro-Harmonic Society.—The smoking concert of this Society, to be held to-night at the Cafe Monico, will partake somewhat of a patriotic nature. "The Absent-Minded Beggar," and a new nautical song, "The Gallant English Tar," by one of the musical directors, will be sung by Mr. Ivor Foster, and a string and wind orchestra will perform a nautical selection, "A Life on the Ocean," a descriptive piece illustrating by means of old sea songs, &c., the commission of a man-of-war. No less than 18 songs are "commandeered" in the incidents of commissioning, preparing for sea, leaving England, outward bound, gale, action, victory, rejoicing, homeward bound, and arrival in England, &c, which are cleverly orchestrated in this fantasia, and the names of Dibdin, Braham, Shield, Davy, Arne, Russell, Boyce and others prove convincingly that the best of our sea songs have been brought to the front. Other instrumental items for violin and piano, songs, duets, humorous sketches and orchestral selections will make up a programme of more than ordinary interest.

The Death of Prof. Hughes.—Our readers will join with us in feelings of deepest regret at the death of Prof. D. E. Hughes, F.R.S., which occurred on Monday last, at the age of 69 years. We shall refer at greater length to his life and work next week, but in the meantime we may remind our readers that in our Journal for November 15th, 1878, they will find a photograph of the late professor, and an account of his career up to that time. We understand that a memorial service will be held at All Saints, Langham Place, at 10.30 on Saturday morning, the funeral taking place at Highgate Cemetery at 12 o'clock the same day.

The Chinese Minister at Bristol.—The Chinese Minister, Sir Chih Chen Lofengluh, spent three days in Bristol this week, and during his visit had many opportunities of judging the important part which electricity is playing in our social and industrial life. He was accompanied by his two sons and three attachés, and on Monday visited the Civic Electrical Station, where he was received and shown round by the engineer, Mr. Faraday Proctor. The station is now packed with machinery, the limits of the capacity of the site having been reached. Two alternators of 150 H.P., four of 350 H.P., and four of 700 H.P. were in use and the additional station, preparations for building which are now being made on another site, will start with two alternators of 1,200 H P. each. There are also numerous dynamos producing continuous current for the street arc lighting and for motor purposes, in the existing station. The attention of his Excellency appeared particularly drawn to the automatic stoking, and he expressed surprise that so good a system was not in use at some other big works he had been to. Among other visits was one to the Avonmouth dock, where the Chinese visitors were shown the electrical generating station now being equipped to light the dock and its buildings by electricity, and to operate all the mechanical appliances in the huge granary now on the verge of completion. This monster building will hold 70,000 quarters of grain, and has in all eight floors. The grain will be distributed to and over this vast floor space by a system of travelling belts, all being operated by electric motors of the Lundell type. To drive the dynamos there have been erected four gas engines, three of 70 H.P. each and one of 30 H.P., all being worked by producer gas manufactured very cheaply at the docks.

Personal.—Sir William H. Preece, F.R.S., has been elected a director of the London Electric Supply Corporation, Limited.

The Edinburgh Electric Light Committee has recommended, and the Town Council approved, that the present salary of £600 of the resident electrical engineer be increased to £750 per annum.

The Plumstead Vestry has appointed Mr. J. B. Mitchell, chief electrical engineer, Southend-on-Sea Corporation, to the post of electrical engineer, at a salary of £400 per annum.

Niagara Turbines.—On Tuesday, January 9th, writes our Niagara Falls correspondent, Dr. Coleman Sellers, chief engineer of the Niagara Falls Power Company, and William A. Brackenridge, resident engineer of the same company, sailed from New York city on the North German Lloyd steamer *Columbia*, for Genoa. From Genoa they will go to Geneva, Switzerland, where they will meet the famous Swiss engineers Piccard and Pictet. The mission of Messrs. Sellers and Brackenridge is of the utmost importance to the future power development of Niagara Falls, for they will consult with these eminent Swiss engineers on the advisability of making changes in the turbines to be installed in the new wheel-pit now building for the Niagara Falls Power Company. It will be recalled that MM. Piccard and Pictet designed the turbines in the present wheel-pit, and they will be asked to consider certain changes and improvements which the experience of the Niagara Falls Power Company has suggested. It is known the world over that the Niagara Falls Power Company is the most progressive company of its kind in the world, and that it stands ever ready to adopt every improvement advocated and suggested by its engineers. The Swiss engineers mentioned are the most famous hydraulic engineers in the world. From this consultation, no doubt Niagara and its power interests will largely benefit, and notable results may be expected from the decision of the engineers. Messrs. Sellers and Brackenridge will be absent about six weeks, when it is expected they will return with new designs. While the turbines were designed in Switzerland, they were made by the I. P. Morris Company of Philadelphia, where no doubt the turbines for the new pit will be made on the improved pattern, if it is adopted.

The Royal Society.—Yesterday afternoon the following were amongst the papers read:—Dr. M. Maclean, "On the Effects of Strain on the Thermo-Electric Qualities of Metals." Part II. Prof. J. C. Bose, "On the Periodicity in the Electric *Touch* of Chemical Elements." Preliminary Notice.

The Electrical Engineers Volunteers.—The *Times* states that the Secretary of State for War has accepted the offer recently made of a detachment of the Electrical Engineers (Volunteers) for service in South Africa, and £3,000 has been set apart for their equipment.

Society of Architects.—Before this Society yesterday evening an interesting paper on "The Designing of Electric Lighting Generating Stations," (with limelight illustrations) was read at St. James's Hall, Piccadilly, by Mr. Alfred Roberts, M.S.A.

An Electrically-Worked Aerial Bridge.—In the Newport (Mon.) Corporation Bill is a proposal to construct an aerial bridge over the Usk. The width of the river at the point selected is 240 yards, and the time occupied by the carrier going from one bank to the other is estimated at about a minute. The motive power will be electricity obtained from the municipal supply station. The aerial bridge will cost £65,000, as against £770,000 if a vehicular subway had been decided upon.

American Municipal Electricians.—It has been arranged that the next convention of the International Association of Municipal Electricians shall be held at Pittsburg on September 25th, 26th and 27th. This association, which has been in existence for four years, includes among its members representatives of over 400 U.S. municipalties. It is stated that some prominent European electrical engineers have been invited to attend.

Appointment Vacant.—The Southport Corporation wants an electrician-in-charge for the electricity works. See "Official Notices" to-day.

The Glasgow Branch of the Institution.—On 18th inst., Prof. Perry, F.R.S., as senior vice-president of the Institution of Electrical Engineers, delivered an introductory speech to the first meeting of the Glasgow branch of the Institution.

Proposed "Send-Off" for the Electrical Volunteers.—The following is a copy of a letter which has been written by Mr. H. Edmunds, as treasurer of the Electrical Engineers' Dinner Fund, to the secretary of the Institution :—

[COPY.]

Westminster, *January 24th*, 1900.

W. G. McMillan, Esq.,
Secretary of the Institution of Electrical Engineers,
28, Victoria Street, S.W.

Dear Mr. McMillan:—Electrical Engineers (R.E.) Volunteer Corps.

As you are probably aware, some 53 members of this corps will shortly leave for South Africa ; and it has been suggested by several members of the Institution that it would be well to give the corps a good send-off in the shape of a dinner at some early and convenient period before they start. To this end I have been asked to become one of the committee, and to act as treasurer in connection with the scheme. Feeling that many members of the Institution would probably like to take part in this gathering, I write to you as secretary, to ask you to bring this matter before the Council meeting to-morrow, in order that they may consider in what way notice should be given to the members and associates in regard to the proposal, which is this, that a dinner should be given, and tickets charged at £2 each, part being for payment of the dinner as for the members and guests, and the balance to be applied to a fund for the corps.

If you will kindly bring this forward, you will greatly oblige,

Yours faithfully,

(Signed) HENRY EDMUNDS.

Mr. Edmunds, as treasurer, will be pleased to receive subscriptions at 2, Queen Anne's Gate.

NEW COMPANIES REGISTERED.

Taipo Accumulator Company, Limited (64,832).—This company was registered on January 20th, with a capital of £25,000 in £1 shares, to acquire British Patent No. 2,299, of 1899, granted to J. G. Hathaway for improvements in the manufacture of electric accumulators and secondary batteries, together with the option of purchasing the German, French, and Belgian patents for the same, and to take over and carry on the business of an accumulator, battery, motor, electric vehicle, rubber and gutta-percha manufacturer and merchant now carried on by J. G. Hathaway at 101, Clifton Street, Finsbury, E.C. The first subscribers (each with one share) are:—G. D. Freeman, 16, Paul Street, Finsbury, solicitor; J. G. Hathaway, Hampton Lodge, Bedfont, Middlesex, engineer; A. Mackmurdo, Jewry House, Old Jewry, E.C., architect; G. E. Winthrop, 4, Playfair Mansions, Queen's Club Gardens, W., gentleman; A. P. Freeman, 60, Madeley Road, Ealing, W., secretary; A. J. Howell, 9, Warwick Road, Upper Clapton, accountant; and R. Lance, 7, Huntingdon Street, Barnsbury, N., clerk. The first directors, to number not less than three nor more than six, are G. D. Freeman, E. Mann, A. H. Mackmurdo, L. Major, and J. G. Hathaway; qualification, £250; remuneration as fixed by the company.

Fireproof Electric Switchboard Company, Limited (64,799).—This company was registered on January 17th, with a capital of £1,000 in £1 shares (500 preference shares), to carry on the business of manufacturing electricians and manufacturers of fireproof switches and switchboards, and to acquire and turn to account any patents, rights, brevets d'invention, licenses, protection, concessions, or privileges. The first subscribers (each with one share) are:—James O. Dale, 12, Bennett's Hill, Birmingham, solicitor; William E. Godfrey, 27, Clifton Road, Sparkbrook, Birmingham, solicitor's clerk; Thomas Newcombe, 2, Birch Grove, Liscard, Cheshire, chemist; Joseph E. Carr, The Limes, Seabank Road, New Brighton, railway clerk; Thomas M. Hamson, 3, Birch Grove, Liscard, gentleman; James W. Bennett, Tower Cliff, New Brighton, manager; and John E. Robinson, 62, Queensland Street, Edge Hill, Liverpool. The number of directors is not to be less than two nor more than five. The first are James O. Dale (chairman) and Percy H. Byrd (managing director, with £5 per annum as remuneration); qualification, one share. Registered office, 9, Canning Chambers, Canning Dock, Liverpool.

South Wales Electrical Power Distribution Company, Limited (64,780).—This company was registered on January 16th, with a capital of £30,000 in £10 shares, to produce, store, supply and sell electrical energy and power, and electricity of all kinds, for public and private lighting, traction power, heating or other purposes, and to carry on the business of electricians and electrical engineers in all its branches. The subscribers are:—A. Hood, Sherwood, Cardiff, colliery proprietor (with 100 shares); T. F. Brown, Cardiff, civil engineer (with 100 shares); W. T. Lewis, Bart., Aberdare, civil engineer (with 100 shares); E. P. Martin, Dowlais, civil engineer (with 100 shares); R. Forrest, St. Fagans, land agent (with 50 shares); E. Rüffert, 39, Lombard Street, E.C., merchant banker (with 50 shares); A. T. Walker, Leeds, civil engineer (with 100 shares); and A. Kelly, Birmingham, manufacturer (with 100 shares). The management is vested in a committee of not less than four nor more than seven members; the first are to be appointed by the subscribers; remuneration as fixed by the company. Registered office, 1, Frederick's Place, E.C.

General Tramways Construction Syndicate, Limited (64,786).—This company was registered on January 16th, with a capital of £200,000 in £1 shares, to enter into any contracts for the construction of the tramways, the subject of the concessions dated December 22nd, 1898, and July 1st, 1899, granted by the Federal Assembly of the Swiss Republic to François Forestier for the construction of tramways in the Canton of Geneva, and to carry on the business of tramway, railway, wharf, dock, telephone, telegraph, and electric, and other works, proprietors and managers, &c. The first subscribers (each with one share) are:—L. Neumann, Warnford Court, E.C., stockbroker; A. Marc, Warnford Court, E.C., stockbroker; A. Ries, Warnford Court, E.C., stockbroker; T. H. Lowinsky, Warnford Court, E.C., stockbroker; E. J. Hallerstadt, Warnford Court, E.C., stockbroker; C. Schmidt, Warnford Court, E.C., clerk, and E. J. Burridge, Warnford Court, E.C., clerk. The first directors are L. Neumann and A. Ries (representing Messrs. L. Hirsch & Co.), H. A. Butters and General N. Harris (representing Messrs. Butters and Hammond), and J. M. Lucach (representing the Exploration Company, Limited); remuneration, £200 per annum for the chairman and £100 each for the others.

Longstreth's, Limited (64,823).—This company was registered on January 19th, with a capital of £3,000 in £1 shares, to carry on the business of electrical, gas, and mechanical engineers, lamp and electrical instrument makers, manufacturing chemists, &c. The first subscribers (each with one share) are:—G. C. R. Marshall, 188, Fleet Street, E.C., solicitor; A. W. Bainton, 7, King's Bench Walk, Temple, barrister; G. P. Ness, 19, Porchester Terrace, barrister; E. Smale, 188, Fleet Street, E.C., clerk; W. H. Randall, 4, Treherne Road, North Brixton, clerk; H. P. Etheridge, 13, Wynne Road, Brixton, S.W., shorthand writer; and H. H. Hussey, 188, Fleet Street, E.C., shorthand writer. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

African Trans-Continental Telegraph Company, Limited (37,855).—This company's annual return was filed on January 3rd, when 170,300 shares were taken up out of a nominal capital of £300,000 in £1 shares; £169,315 has been paid (including £10 on 20 forfeited shares), leaving £995 due.

Electric Lighting and Traction Company of Australia, Limited (63,334).—This company's annual return was filed on January 4th, when 3,403 ordinary and 20,000 preference shares were taken up out of a nominal capital of £300,000 in £5 shares (30,000 ordinary and 30,000 preference). £3 per share has been called on 2,003 ordinary and 20,000 preference, resulting in the receipt of £66,009; £7,000 is considered as paid on the remaining 1,400 shares.

Volenite, Limited (57,337).—This company's annual return was filed on January 5th, when 79,934 shares were taken up out of a nominal capital of £80,000 in £1 shares; £34,934 has been received, and £45,000 is considered as paid.

Automatic Electric Railway Signal Company, Limited (37,636).—This company's annual return was filed on December 7th, 1899, when 5,940 shares were taken up out of a nominal capital of £10,000 in £1 shares. £1 per share has been called up on 1,640, and £1,647 10s. has been paid, including £7 10s. on 15 forfeited shares. £4,300 is considered as paid.

Bright's Light and Power, Limited (58,290).—This company's annual return was filed on January 5th, when 100,000 ordinary shares were taken up out of a nominal capital of £200,000 in 100,000 ordinary and 100,000 preference shares of £1 each. £1 per share has been called up on 7, and 10s. per share on 66,660. £20,683 10s. has been received, leaving £12,653 10s. in arrears. 33,333 shares are considered as fully paid.

Electric Fur Machinery Company, Limited (53,742).—This company's annual return was filed on January 12th, when 556 shares were taken up out of a nominal capital of £3,600 in £1 shares. £550 is considered as paid, and 16 shares have been paid for in full.

Central Electric Supply Company, Limited (53,080).—This company's annual return was filed on January 12th, when 307 shares had been taken up out of a nominal capital of £100,000 in 20,000 £5 shares. £1 has been called and paid on each of 300; nothing on 7.

SUPPLY STATION ACCOUNTS.

Bath Corporation Electricity Accounts.

The accounts of the Bath electric lighting undertaking, now in the hands of the Corporation, show that comparatively slow progress is being made. No doubt the business labours under some disadvantages, and has inherited some of these from the time the local company handed the business over to the Corporation. We expect to see more rapid growth when the engineer, Mr. Metzger, has got rid of some of the old-standing troubles, and is able to proceed on his own lines. The station is still comparatively a small one, and there should be ample scope for increasing the demand, which, at the end of 1898, stood at 330 kw. The general position of the undertaking is shown as follows:—

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£32,938	£51,561	£18,623
Number of units sold	314,720	356,700	41,980
Total maximum supply demanded	315 kw.	330 kw.	15 kw.
Gross revenue	£7,009	£7,113	£104
Gross profit	£1,688	£1,478	−£210
Average price per unit sold ...	4·80d.	4·48d.	−·32d.

The output was taken in large part by the public lamps, being distributed as follows:—

	Quantity generated.	Sold public lamps.	Sold private consumers.	Number of public lamps.
1897 ...	514,224	138,200	176,520	88 arcs.
1898 ...	537,052	169,385	187,315	87 arcs and 21 incandescents of 16 c.p.

Each item in the revenue account shows a fall per unit—current by nearly the third of a penny, and the supply of lamps, &c., by over the fifth of a penny.

Revenue Statement.

	1897.		1898.		
	Gross.	Per unit.	Gross.	Per unit.	Increase.
Sale of current	£6,300	4·80d.	£6,665	4·48d.	−·32d.
Meter rents	219	·17d.	237	·16d.	−·01d.
Supply and repairs of lamps, &c.	395	·30d.	123	·09d.	−·21d.
Sundry fees, &c.	95	·07d.	88	·06d.	−·01d.
Gross revenue ..	£7,009	5·34d.	£7,113	4·79d.	−·55d.

In the costs, the works items have all fallen, and especially is this notable in "repairs," while coal has been reduced, and in view of the high prices current in 1898, compared with the previous year, this is decidedly satisfactory. We do not know how Mr. Metzger managed to obtain a reduction in rates from £127 in 1897 to £84 in 1898, but it is, although unusual, a fact on which he is to be congratulated. Management and establishment charges show an upward tendency, but even at the present figures these items are quite reasonable.

Cost of Production.

	1897.		1898.		
	Gross.	Per unit.	Gross.	Per unit.	Increase
Coal	£1,871	1·42d.	£2,107	1·41d.	−·01d.
Oil, waste, water, and engine room stores.	386	·30d.	432	·29d.	−·01d.
Salaries and wages incurred in generation and distribution.	811	·62d.	892	·60d.	−·02d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	985	·75d.	614	·42d.	−·33d.
Works' costs	£4,053	3·09d.	£4,045	2·72d.	−·37d.
Rent, rates, and taxes ..	181	·14d.	137	·09d.	−·05d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	946	·72d.	1,217	·82d.	+·10d.
General establishment charges, stationery and printing, law charges and insurance.	128	·10d.	173	·12d.	+·02d.
Other expenses	13	·01d.	63	·04d.	+·03d.
Total costs ...	£5,321	4·06d.	£5,635	3·79d.	−·27d.

The Profit Statement is complicated by the way the surplus for 1897 was dealt with. This was shown at £645, and "carried forward." To this the gross profit of 1898, amounting to £1,477, was added, and the aggregate allowed £1,501 to be paid toward interest charges, £747 to be transferred to sinking fund, and a balance, shown at £125, is carried forward. The figures for 1898 within parentheses indicate this allocation of the monies mentioned. On the other hand, the revenue in 1897 was credited with "stores on hand," which we have treated as an asset and eliminated from the revenue statement.

Profit Statement.

	1897.	1898.
Interest on loans	£707	£1,478
Sinking fund for repayments	600	(747)
Net profit, carried forward	381	(125)
Gross profit	£1,688	£1,478

CITY NOTES.

Direct United States Cable Company, Limited.

The directors' report for the six months ended December 31st, 1899, to be presented at the meeting to be held at Winchester House on Tuesday, January 30th, 1900, at 2 o'clock, p.m., reads:—

The usual statements of account for the half-year ended December 31st, 1899, are submitted herewith. The half-year's revenue, after deducting out-payments, amounted to £56,800 2s. 5d., as compared with £64,366 4s. 10d. for the corresponding period of 1898, showing a difference of £2,433 17s. 7d. in favour of the half-year under review. The working and other expenses for the same period, including income-tax, but exclusive of cost of cable repairs, amounted to £20 416 10s. 5d., leaving a balance of £36,383 19s. as the net profit, making, with £3,176 16s. 9d. brought forward from the previous half-year, a total of £39,560 8s. 9d. For the corresponding period of 1898 the working expenses and other payments amounted to £21,620 19s. 11d. Interim dividends of 3s. per share for the quarter ended September 30th, 1899 (paid October 24th, 1899), and of 3s. per share for the quarter ended December 31st, 1899 (payable January 31st, 1900), together amounting to £18,213, have been declared, and after setting aside £15,000 to the reserve fund account, the balance of £6,347 8s. 9d. on the revenue account has been carried forward. The reserve fund account has been debited with £1,989 16s. for cost of cable repairs, and after being credited with interest on the investments and amount set aside from revenue, the balance of the reserve fund account, taking the investments at cost price, now amounts to £401,693 16s. 2d. The late traffic manager having resigned, the directors have appointed Mr. Tavenor Finnis general manager, and Messrs. Clark, Forde & Taylor consulting electricians of the company.

Eastern Telegraph Company, Limited.

The report for the half-year ended September 30th, states that the revenue amounted to £474,950, from which are deducted £121,630 for the ordinary expenses, and £33,096 for expenditure relating to repairs and renewals of cables, &c., during the half-year. After providing £6,117 for depreciation of spare cable and £7,215 for income-tax, there remains a balance of £306,890, to which is added £3,536 brought from the preceding half-year, making a total available balance of £310,426. From this balance there has been paid interest on debentures and debenture stock and the dividend on the preference stock and two interim dividends of 1½d. per cent. each on the ordinary stock. After carrying £10,000 to reserve for maintenance ships, £5,000 to the reserve fund in connection with the removal of head offices. £2,000 to insurance of goods in transit fund, and £100,000 to the general reserve fund, there remains a balance of £33,660 which is carried forward. The revenue includes £24,054 dividends for the half-year upon the company's shares in other telegraph companies. With a view of providing additional security to submarine telegraph communication between this country and South Africa, landing rights at Cape Town have been obtained from the Government of the Cape of Good Hope for a third cable between this country and South Africa. The first section, from Cape Town to St. Helena, was completed on November 26th last, a further section being laid from that island to the island of Ascension on December 16th. The continuing cable to be laid thence to St. Vincent is now being manufactured, and it is expected the expedition will leave the Thames the end of this month. Reference was made at the last general meeting to proposed new cables between South Africa and Australia, and a proposal has been submitted by the Eastern Extension, Australasia, and China Telegraph Company, in conjunction with this company, for carrying out this important extension. By the terms of the proposed agreement, the tariff is to be reduced at once between Great Britain and Australia to 4s. per word, to be followed by further reductions on a sliding scale to 2s. 6d. per word, according to the growth of revenue from this traffic. The companies have made this offer conditional on the Eastern Extension Company being granted the same rights in dealing direct with the public in Australia as it enjoyed in this and other countries.

Edmundson's Electricity Corporation, Limited.

An extraordinary general meeting of this corporation was held at the offices, Broad Sanctuary Chambers, Westminster, on Friday, 19th inst., when a resolution was carried increasing the borrowing powers of the company. At the present time the borrowing powers are limited to an amount equal to one-half the subscribed capital. The alteration to the articles will increase the borrowing powers to an amount equal to the subscribed capital.

Prospectuses.

The prospectus has been issued of the Taipo Accumulator Company, which is being promoted with a capital of £25,000, divided into 20,000 ordinary and 500 preference shares of £1 each. Of this the vendor, a Mr. J. G. Hathaway, who is also the inventor of the accumulator, receives £20,000, payable as to £2,000 in cash, or cash and shares, and the balance in ordinary shares, leaving £5,000 for working capital. It is claimed that the Taipo accumulator is light, indestructible, and cheap to make and maintain, all of which we have heard before, of other cells. A small sample, of 40 ampere-hours capacity only, has been tested for eight months by the company's consulting engineers, and "*favourably reported upon*," but the report is not printed; counsel's opinion has been taken on the validity of the patent, and, like the report, may be seen at the company's office, where not one in 50 of the prospective investors will ever go to see them.

As an illustration of the qualities of the Taipo cell, particulars are given of what the company "will be able to supply" in the form of a battery for lighting bicycles.

In order to pay 6 per cent. on the preference, and, say, 5 per cent. on the ordinary shares, a net profit of £1,300 must be earned, with a working capital of £5,000; this implies a turnover of £6,000 or £7,000 a year.

In the total absence of particulars of the construction of the accumulator, we cannot, of course, express an opinion on its merits; as regards the construction of the concern, however, we have very decided views. In the absence of details, we advise our readers to let it alone.

A prospectus has been advertised locally by a company formed by Messrs. Edmundson's Electricity Corporation for working the Montrose and Brechin provisional orders. The name of the company is the Angus Electric Light and Power Company, Limited, and the capital £25,000. The list is open until February 2nd.

Anglo-American Telegraph Company, Limited.—The board has resolved, after placing the sum of £12,000 to the credit of the renewal fund for the half-year, to recommend the meeting to be held on February 2nd, the declaration of the following dividends:—

1. A balance dividend of £1 8s. 6d. per cent. upon the ordinary consolidated stock for the year ending December 31st, 1899.
2. A balance dividend of £1 10s. per cent. upon the preferred stock for the year ending December 31st, 1899.
3. A first and final dividend of £1 7s. per cent. upon the deferred stock for the year ending December 31st, 1899, all payable on February 3rd next, less income tax to the stockholders registered on the books of the company on January 15th.

After paying the foregoing dividends there will be a balance of about £1,355, to be carried forward to the next account. The above dividends together with those already paid will amount to £3 13s. 6d. per cent. on the ordinary consolidated stock £6 per cent. on the preferred stock, and £1 7s. per cent. on the deferred stock for the year 1899. The register of transfers will be closed from January 19th to February 2nd, both days inclusive.

The St. James's and Pall Mall Electric Light Company, Limited.—The directors of St. James's and Pall Mall Electric Light Company, Limited, recommend a dividend for half-year ending December 31st of 7s. 6d., together with a bonus of 2s. per share on the ordinary shares, making with the interim a dividend of 12½ per cent., and a bonus of 2 per cent. for the year 1899.

City and South London Railway Company.—The The accounts for half-year, 1899 show a balance, after providing for the debenture interest and the dividend on the preference stock (1891), sufficient to allow the payment of a dividend on the consolidated ordinary stock (increased to £855,000) at the rate of 1½ per cent. per annum, carrying forward a balance of £1,267. The dividend for corresponding period last year was at the rate of 2 per cent. per annum, the balance carried forward being £1,419.

W. T. Henley's Telegraph Works Company.—Sir Henry M. Stanley, G.C.B., M.P., has accepted a seat on the board of this company.

Waterloo and City Railway Company.—The directors recommend a dividend on the ordinary stock at the rate of 3 per cent. per annum for the half-year ended December 31st.

City Meetings.—Yesterday (Thursday) meetings of the Eastern Telegraph Company and the Automatic Telephone Company were held. Reports will appear next week.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending January 20th, 1900, were £140 2s. 0d.; receipts for corresponding period, 1899, £129 17s. 2d.; aggregate for half-year to date, £426 9s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending January 19th, 1900, were £2,715 1s. 4d.; corresponding period, 1899, £2,578 11s. 8d.; increase, £136 9s. 8d.

The City and South London Railway Company.—The receipts for the week ending January 21st, 1900 were £1,111; ditto January 22nd, 1899, £1,139; decrease, £22. Total receipts for half-year, 1900, to date, £3,379; corresponding period, 1899, £3,383; decrease £4. Miles open, 8½

The Dover Corporation Tramways.—The receipts for the week ending January 20th, 1900, were £149 16s. 11d.; January 21st, 1899, £148 5s. 9d.; increase, £1 11s. 2d. Total receipts to date, 1900, £455 2s. 6d.; corresponding period, 1899, £454 13s. 11d.; increase, 8s. 7½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,989; 1899, 4,172. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, January 19th, 1900, were as follows:—D. U. T. Co., horse cars, £97 15s. 2d.; ditto, electric cars, £2,764 18s. 10d.; D. S. D. Co., electric cars, £608 10s. 6d.; total, £3 571 4s. 6d.; corresponding week last year—D. U. T. Co., horse cars, £2,044 11s. 4d.; ditto, electric cars, £577 8s. 9d.; D. S. D. Co., electric cars, £630 11s. 3d.; total, £3,252 11s. 4d.; increase, £318 13s. 2d. Aggregate to date, £7,867 1s. 7d.; aggregate to date last year, £8,734 18s. 0d.; increase to date, £883 3s. 7d. The mileage worked is 40 miles electrically, 4 miles by horses, as against 16 miles electrically, 28 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending January 21st, 1900 amounted to £1,471: corresponding week last year, £1,326; increase, £145; total for half-year to date, £453.

The South Staffordshire Tramways Company.—The receipts for the week ending January 19th, 1900, were £608 7s. 8d.; January 20th 1899, £579 1s. 2d. Aggregate receipts for 3 weeks, £1,615 10s. 3d.; last year, £1,765 17s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

THE growing return of confidence in the stock markets to which we have alluded since the beginning of the year, shows no signs of waning. In fact, the tendency is still hopeful, and prices of electrical descriptions, as will be seen by our two following pages, are on the up grade, taken as a whole, the rises outnumbering the falls by more than 8 to 1. Of course, the days of dividends are at hand, and quotations, now carrying the expected distributions, naturally firm up, and this factor has been powerful to aid our markets during the current week.

In speaking about dividends, the declaration made the other day by the Anglo-American Telegraph Company claims the first place, on account of the interest that it excited for months beforehand. The Deferred stock, Anglo "A," is to receive a dividend for the year at the rate of 27s. per cent., comparing with 18s. per cent. for 1898. This, excellent though it is, rather disappointed the hopes of some of the more sanguine speculators, who were indulging in hopes of a dividend of 30s. per cent., and both "A" and "B" stocks were heavily offered at the time. The Ordinary stock, however, has managed to retain a rise on the week.

Eastern Telegraph Ordinary and Preference are both up, although not retaining the full amount of the advance which they had gained at the week's commencement. The Ordinary stock now shows a gain of 6¼ per cent., allowing for the dividends, since we advised a purchase a fortnight ago, but it is still far below the price ruling last year, when the stock touched 183 in February and March. Eastern Extensions have come into favour this week, and the Debenture stock is higher, but the rumours circulated in the Stock Exchange on Tuesday, with regard to a severe British disaster outside Ladysmith caused a dull tone to supervene in all the markets. Globe Telegraph and Trust, however, kept their improvement, and Brazilian Submarines are again fractionally harder.

In the Electricity Supply list, a fair number of gains has to be recorded. The most activity has been noticeable in "Jimmies," as the market calls St. James's and Pall Mall Electric shares. The authorities forecast a dividend at the same rate as last year's, but the price would not have risen as it has done if that were all that they expected. Continuing the lists of tables which we have been lately giving, it is extremely interesting and instructive, as the children's books say, to compare present quotations with those of January, 1899. We give the highest and lowest in that month, together with the closing prices this, Wednesday, afternoon.

Shares.	January, 1899.		Now.
	Highest.	Lowest.	
Brush Ordinary	1¹⁵/₁₆	1⅞	1⅞
City of London	25½	22½	11
Metropolitan	20	17⅛	15
St. James's	17¹¹/₁₆	16⅝	16
Westminster	1⅝	15½	15

With the unimportant exception of Brush Ordinary, it will be seen at a glance that in every case a fall has taken place, that in the City of London's being £14 17s. 6d. per share from the highest touched in the corresponding month of 1899.

The Welsbach Company, whose stocks enjoyed a brief flicker upwards a few weeks ago upon the news that the company had now perfected its invention for applying the incandescent system to electric lights, has been the subject of a strong attack by a "financial expert." He issued a circular advising in no hesitating terms the immediate sale of the stock, and to his circular the secretary replied in a letter counselling stockholders not to throw away their securities on the strength of the statements made by this "expert." The Ordinary stock, which was forced down to 50 last Saturday, quickly recovered to 56, and the incident has attracted a great deal of attention in the market this week.

Electric traction stocks are steady; that is all that can be said about them. A small amount of buying sufficed to put British Electric Preference 5s. better, the same amount of rise as was chronicled last week. The railway market is quite changeless. City and South London shareholders will be glad to learn that their board of directors is acting in harmony with that of the Great Northern and City Railway, the two companies having agreed to make a joint station in Old Street. What railway dividends and reports have already appeared cannot be considered very hopeful, but City and South London stockholders who follow this column will not be surprised at the reduction which has taken place in their dividends for the past half-year.

National Telephone shares are better, and in the manufacturing section rises have occurred, most notably in Telegraph Construction and Henley's Ordinary shares.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, Jan. 17th.	Closing Quotation, Jan. 24th.	Business done during week ended Jan. 24th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	64 — 67	65 — 68	67	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	114½—115½	115 —116	115½	114½
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	17¼— 17¾	17¼— 17¾	17 15/16	17⅛
206,993	Brazilian Submarine Telegraph	10	7 %	...	...	14½— 15	14½— 15½	15	14 13/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	106 —109	106 —109	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	...	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,332,823£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103⅜	102¾
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	1 %	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	7 %	8 %	...	8½— 9½	8½— 9½	9½	9 1/16
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19 — 20	19 — 20	19½	...
12,931	Direct Spanish Telegraph	5	4 %	...	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101—105%	101 —105%	...	...
60,710£	Direct United States Cable	20	3¼%	3¼%	...	11¾— 12¼	11¾— 12¼	12⅛	12
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	151 —156 xd	153 —158	156	152½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	96 — 99 xd	98 —101	100	98¼
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	114 —119	115 —120	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	14¾— 15¼xd	15¼— 15⅝	15⅝	14⅞
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	116 —121	117 —122	...	...
17,400	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red., Reg. Nos. 1 to 2,343	100	...	...	...	... ...	... ...	...	...
24,500	Do. do. do. to bearer, 2,344 to 5,500	100	...	...	...	... ...	... ...	...	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	...	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	...	...	...	101—104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	...	10¾— 11¼	11 — 11½	11¼	11
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	14¾— 15¼	15 — 15½	15½	15 1/16
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	...	...	30 — 32	30 — 32	31¾	31
86,300	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	48 — 52	49 — 53	52½	50
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	...	...	106 —109	106 —109	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	...	...	...	⅜— 1	⅜— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	...	5⅜— 5⅝	5⅜— 5⅝	5⅝	5½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	...	5¼— 5½	5⅜— 5⅝	5⅝	5 5/16
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	...	98 —100	98 —100	99½	98⅛
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅜— 1	⅜— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's	8	5 %	...	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust -	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	6 %	...	...	4⅜— 5¼	4⅜— 5¼	...	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	99 —102	99 —102	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	100 —104	100 —104	...	...
88,821	West India and Panama Telegraph	10	8%	...	...	¾— 1⅛	¾— 1⅛	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	9¼— 9¾	9¼— 9¾	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	7 — 8	7 — 8	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	...	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	...	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	...	...	9 — 10	8½— 9½	...	...
80,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	...	9½— 10½	10 — 11	10 1/16	10 9/16
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9½— 10½	9½— 10½	10	9 9/16
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5⅝— 6¼	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	6 %	6 %	...	7½— 8½	7½— 8½	8	7 13/16
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	...	...	109 —111	109 —111	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	10 %	6 %	...	10 — 11	10½— 11½	11⅛	10 3/4
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½— 13½	13 — 14	13⅜	13⅜
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	...	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	13 — 14	13 — 14	...	...
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	106 —109	108 — 111	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4⅜— 5½	4⅜— 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	2¼— 2⅜	2 — 2⅜	...	...
48,050	Do. do. do. 6 % Pref.	5	...	6 %	...	5¼— 5⅜	5 — 5⅜	5¼	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	102 —104	101 —103	102	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	...	14 — 15	14½— 15½	14 11/16	14½
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	13½— 14½	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	115 —117	115 —117	...	...
125,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	96	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	...	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	14½ %	14½ %	14½%	15 — 16	15½— 16½	16⅜	15⅞
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4 — 4½	4 — 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	12 %	12 %	...	14 — 15	14½— 15½	15½	14⅝

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Jan. 17th.	Closing Quotation Jan. 24th.	Business done during week ended Jan. 24th, 1900. Highest.	Lowest.
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	...	...	2⅞— 3¼	2⅞— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	6 %	...	15½— 16½	16 — 17	16⅝	15¼
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13 — 13½	13½— 13⅝	13⅝	13 5/16
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	125 —128	...	...
45,000*l*	British Electric Works Co., Ord. £1 shares, 50,001—95,000	...	...	...	...	⅝— ¾	⅝— ¾	...	...
50,000	Do. do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	⅝— ¾	⅝— ¾	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½— 12¼	11½— 12¼	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6 — 6¼xd	6 — 6⅛	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅝— 2	1⅝— 2	1 11/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	...	13 — 14	13½— 14½	13⅜	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110 —115	110 —115	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	9½— 10	9½— 10	9 15/16	9⅜
61,083	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4½— 5	...	...
71,447	Do. do. Def. do.	5	...	...	...	4½— 5	4½— 5	...	...
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	59 — 62	59 — 62	60	59
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000 £5 10s. pd.	10	...	...	...	4½— 5½	4½— 5½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4 xd	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	98 —101	98 —101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1⅞— 2⅛	2 — 2⅛	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	...	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	91 — 93	92 — 94	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅞— 2⅛	2 — 2⅛	2⅛	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	...	2⅛— 3⅛	2⅜— 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106 xd	103 —106	103	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅝	⅝— ⅝	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	...	12 — 13	13 — 14	13⅜	...
12,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5½— 5⅝	5½— 6	5⅝	5⅜
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½— 21½	21 — 22	21¼	21
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3½%	...	8 13/16— 8 15/16	8 11/16— 8 13/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	...	13 — 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	...	35 — 39	36 — 40	39½	36½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ...	5	...	...	...	9 — 10	9 — 10	...	...
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½— 6	5½— 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	101 —104	101 —104	101½	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 102—105.
National Electric Free Wiring, 10s. paid, 5s.—7s.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, 1—2.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7—7½. Debentures, 102—105. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 4½ per cent. (January 18th, 1900).

MARKET QUOTATIONS, Wednesday, January 24th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	£29	..
a „ „ „	per ton	£27	£27	..
a Bleaching powder	per ton	£6 10	£6 1	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£24 10	£24 10	..
a Lead, Nitrate	per ton	£25	£25	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£37 10	£37 10	..
Methylated Spirit	per gal.	2/9	2/9	..
Naphtha, Solvent (90 % at 150° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4½d.	5d.	½d. dec.
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	3¾ l.	4¼d.	½d. dec.
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£75 to £135	£75 to £135	..
c Brass (rolled metal 2" to 12") basis	per lb.	8d.	8d.	..
c „ Tube (brazed)	per lb.	10d.	10d.	..
c „ Wire, basis	per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£82	£82	..
g „ Wire (basis price) ..	per lb.	10½d.	10½d.	..
g „ Sheet	per ton	£82	£82	..
g „ Rod	per ton	£82	£82	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	7/-	7/-	..
h India-rubber, Para fine ..	per lb.	4/8½	4/7 to 4/8	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	69/9	68/1	1/8 inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i „ Wire galvanised No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£16 2 6	£16 5	2/6 dec.
g „ „ Sheet	per ton	£18	£18	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 12 6	..
d Mica (in original cases), small	per lb.	2d. to 8d.	2d. to 8d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large	per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet	per lb.	From 1/2½	From 1/2½	..
o Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/	10½d. to 1/	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£124 10 nom.	£120 10 to £121 10 nom.	£4 inc.
g „ foil	per lb.	1/9	1/9	..
n „ wire Nos. 1 to 16	per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. ..	per lb.	5½d.	5½d.	½d. dec.
j „ Hemp, 8 ply 10 lbs. ..	per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£14 10	£14 5	5s. inc.
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£25 5 nett.	£24 5 nett.	£1 inc.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

AN AMERICAN PACIFIC CABLE.*

BY GEORGE OWEN SQUIER.

(*Concluded from page* 118.)

CABLE CONNECTION WITH THE SAMOAN ISLANDS.

The interests of the United States in Samoa will be more clearly defined by the acquisition of sovereignty over the island of Tutuili now reported probable. In this connection another branch of cable is suggested, which the United States could properly assist. As shown upon the accompanying map, a span of cable but 650 miles in length connecting Fiji with Apia, would thus join the Samoan group to the main British Pacific cable route and furnish cable connections for the three Governments interested, viz., England, Germany, and the United States.

CONCLUSION.

After several years of comparatively little advance, the technical and scientific side of telegraphy has received much attention during the past two are three years, until at this moment there is no other special branch of electrical engineering which is more in evidence or promises more for the future.

By whatever method the first Pacific cable is ultimately laid, and provided that it shall appear that all of the projected cable cannot be manufactured and laid in the United States within a reasonable time, it seems plain that the encouragement of American manufacturers in the building up in the United States of a deep sea cable industry of the first class is a wise policy for this Government.

The successful completion of the submarine cable across the Pacific will mark an epoch in the telegraph history of the world. After 30 years of consideration—technical, commercial, and political—the end of this century sees this great enterprise at last seriously undertaken. The full influence which it will exert upon the Western Hemisphere and the world in general is not easily appreciated. Strategically, the importance of this inter-colonial communication and its preservation are very great. However, the Philippine question should not overshadow the larger question—the Eastern question—in the consideration of this project. Important as that cable will be as a means of joining the Philippine archipelago to the United States, its larger importance will ultimately be in the future of the commercial development between the United States and the East. In the broad extension of the Pacific trade consequent upon the completion of the Isthmian canal and the development of steamship lines plying the Pacific, the telegraph cable will naturally become an important factor. The trans-Pacific steamship lines are heavily handicapped by the absence of a direct means of telegraphy between the ports embraced in their routes. Situated on the main trade routes leading from the Isthmian canal to Asiatic ports, the Pacific cable will serve as a powerful adjunct and support to this enterprise. The two go hand-in-hand and are mutually closely related. It can be stated that there is scarcely any point in the world where there is greater need for a central cable station than in the Hawaiian Islands. Geographically situated at the military and commercial strategic position of the North Pacific ocean, it will ultimately serve as the distributing centre of ocean communication between the two hemispheres as well as to various island groups of the Pacific.

As to the probable traffic to be immediately expected there is little direct evidence at hand, since the waters spanned have never before been crossed by a submarine cable. Taking $150.00 as the average earning power per nautical mile of the long cables of the world as a basis, this project should prove a paying investment from the very first, but it is believed that this estimate, based upon the average of cables will prove under rather than above experience, particularly as this route will immediately enter as a competitor for European traffic *vid* the Atlantic cables and United States landlines. The immediate effect of the trans-Pacific cables will be to lower the rates to the East, since European traffic will be open to competition, east and west, and the new Western route, due to the long spans and comparatively few repetitions will have an advantage.

A short span of cable of about 200 miles between Luzon and Formosa connecting with the Great Northern Telegraph Company's route through Siberia, and also between Luzon and a Chinese port, will bring Japan and China into direct connection not only with the North American Continent, but also by two competitive routes east and west with Europe. In fact, the laying of the Pacific cable should operate to readjust the present cable through tariff rates throughout the world upon a lower basis.

* A paper presented at the 138th meeting of the American Institute of Electrical Engineers, New York and Chicago, December 27th, 1899.

APPENDIX No. 1.

PROJECTED PACIFIC CABLE.—DISTANCES IN NAUTICAL MILES.

(UNITED STATES COAST AND GEODETIC SURVEY.)

Provisional routes.	Great circle.	Rhumb line.	Great circle distances + 10 per cent. slack.	Great circle distances + 15 per cent. slack.
San Francisco to Honolulu ..	2,078·43	2,086·86	2,286·27	2,390·19
Honolulu to Midway Island ..	1,139·98	1,140·95	1,253·97	1,310 97
Midway Island to Guam ..	2,293·64	2,299·25	2,523·00	2,637·68
Guam to Dingala Bay, P. I. ..	1,359·95	1,360·50	1,495·94	1,563·94
Totals	6,872·00	6,887·56	7,559·18	7,902·80
San Francisco to Honolulu ..	2,078·43	2,086·86	2,286·27	2,390·19
Honolulu to Wake Island ..	2,004·27	2,008·23	2,204·69	2,304·91
Wake to Guam	1,304·48	1,305·08	1,434·87	1,500·09
Guam to Dingala Bay, P. I. ..	1,359·95	1,360·50	1,495·94	1,563·94
Totals	6,747 08	6,760·67	7,421·77	7,759·14
Guam o Yokohama	1,348·05	1,348·12	1,482·85	1,550·25

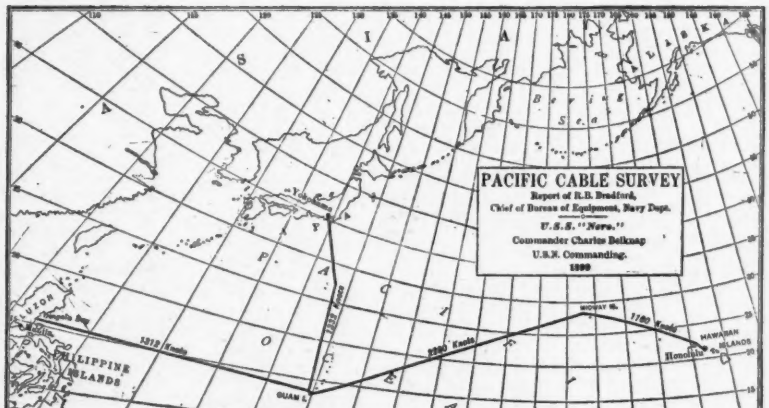
1 mile = 1,853·25 metres, or 6,080·2 feet.

GEOGRAPHICAL POSITIONS ADOPTED.

San Francisco, California, Fort Point, Golden Gate.
Honolulu, Hawaiian Islands, Harbour Light.
Midway Island, or Brooks Island, Welles Harbour.
Wake Island, centre.
Guam, Fort Sta. Cruz, San Luis de Apra.
Dingala Bay, Luzon Island.
Yokohama, Japan, English Naval Storehouse.

The nearest point of the mainland from Honolulu is Point Arena, next Point Reyes, next Point Sur, California. Taking the positions of the lighthouses, the distances to Honolulu are as follows:—

From Point Arena ... ... 2,045·7 nautical miles.
„ Point Reyes ... ... 2,057·5 „ „
„ Point Sur ... ... 2,078·4 „ „



As evidence of the importance of particular secret manipulation during manufacture, independent of the weights of materials employed, and the measured K R of the finished cable, Messrs. Siemens Bros. & Co. have lately issued a table of trans-Atlantic cable speeds, from which the following data is taken:—

TRANS-ATLANTIC CABLES.

TABULAR STATEMENT OF ACTUAL AND CALCULATED SPEEDS.

Date when laid.	Designation of cable.	Length in nautical miles.	Types of core of deep sea cable. Lbs. per nautical mile.	K R *Ohm* × *Micro-farads.* ÷ 10^6	Speeds actually obtained in regular working. 5-letter words.	Calculated speed if lengths 1,860 naut. miles.	Calculated speed if lengths 1,860 naut. miles and core 650/400.
			Cop. G.P.				
1873	Anglo-American ..	1,876	400/400	3·919	..	..	..
1874	Anglo-American ..	1,837	400/400	3·512	20·2 (*a*)	19·9	28·2
1875	Direct United States	3,423	400/360	7·558	22·6 (*b*)	38·6	70·2
1879	Pouyer-Quertier ..	3,942	350/300	6·600	22 (*c*)	32·2	59·8
1866/80	Anglo-American ..	1,852	..	4·532	..	..	..
1881	Jay Gould	3,518	350/300	7·834	21·5 (*d*)	30·8	69·4
1882	Jay Gould	3,563	350/300	8·080	21·5 (*d*)	41·2	71·2
1884	Mackay-Bennett (S.)	1,853	350/300	6·740	26	42·0	72·3
1884	Mackay-Bennett (N.)	2,846	350/300	6·630	26	41·8	71·2
1894	Mackay-Bennett (3rd)	2,161	500/320	4·671	40 (*g*)	54·6	77·2
1894	Anglo-American ..	1,850	650/400	2·420	47·4 (*e*)	47·4	47·4

(*a*) Report of engineers, Messrs. Clark, Forde & Co., to the manager

of the Anglo-American Telegraph Company, dated June 25th, 1877.

(*b*) Report of engineers, Messrs. Clark, Forde & Co., to the manager of the Direct United States Cable Company, dated June 25th, 1877.

(*c*) Report of the engineer-in-chief, Mr. von Chauvin, to the Pouyer-Quertier Cable Company, dated June 15th, 1880.

(*d*) Report of Dr. Muirhead to Mr. von Chauvin, representative in London of the Western Union Telegraph Company, dated July 10th, 1883.

(i) Special trial of code words, 18 words per minute } mean
(ii) Press messages, usual rate, 25 " " } 21·5
(iii) As many as 135 letters per minute have been observed to pass at times without requiring repetition.

(*e*) *Electrician*, dated October 12th, 1894.

(*g*) From a letter from Mr. G. G. Ward, vice-president and general manager of the Commercial Cable Company, dated May 10th, 1895.

APPENDIX No. 2.

TRANS-PACIFIC TELEGRAPH CABLE SURVEY.

[*From Annual Report of Chief of the Bureau of Equipment, Navy Department, November*, '99].

A practicable route for a submarine telegraph cable was established between San Francisco and Honolulu some years ago.

In order to continue the survey of the route from Honolulu to the Philippines, the U.S.S. *Nero*, under command of Commander Charles Belknap, U.S.N., was very thoroughly fitted out and equipped for deep sea exploration at the navy-yard, Mare Island, during the early part of the present year. The *Nero* is a large steam collier purchased for use during the late war, and on account of great steaming radius was admirably adapted to make the survey. After a careful consideration of the subject, it was decided that the best route westward from Honolulu to the Philippine Islands was by way of the Midway Islands and Guam, landing the cable at a convenient point on the east coast of Luzon as near as possible to the latitude of Manila. It was also decided as desirable to survey a route from Guam to Yokohama. Elaborate instructions for the survey were prepared. The plan of the survey, which is represented on the accompanying chart, consists in carrying direct lines of soundings, taken at alternate intervals of 10 and 2 knots, from Honolulu to the Midway Islands, thence to Guam, and thence to Luzon, and also from Guam to Japan. The return course to be pursued is a zigzag line passing back and forth to equal distances on each side of the route followed in going to the westward, with soundings at intervals of 20 knots at the turning points.

The *Nero* sailed from San Francisco for Honolulu on April 22nd. She sailed from Honolulu to commence her work on May 6th. On May 22nd she had completed a single line of soundings to the Midway Islands, by July 4th to Guam, and by August 1st to Luzon.

Along this route, which is 4,312 knots in length, 853 soundings were taken. The characteristics of the bottom soil and the temperature of the surface water were observed at each sounding station, and these, together with the meteorological record and the frequent observations of specific gravity, bottom temperature, and the currents of the ocean, besides their value in laying a submarine cable, will form an important contribution to the physics of the Pacific Ocean.

Two offsets from the projected great circle route between the Midway Islands and Guam were found to be necessary in order to avoid obstacles to a successful laying and operation of a telegraph cable. The first of these obstacles encountered is a submarine mountain situated a short distance westward of the Midway Islands and rising from the floor of the ocean, which here sinks to a depth of 2,200 fathoms, to within 82 fathoms of the surface. The second obstacle is one of the deepest submarine abysses yet found in the world, situated about 500 miles eastward of Guam, and sinking to a depth of more than 4,900 fathoms.

Reports have been received of the preliminary line of soundings from Honolulu to Luzon, and they indicate that the route which is being surveyed will prove entirely practicable.

No reports of the soundings taken on the return trip or of any soundings from Guam to Yokohama have been received.

Owing to illness, Commander Charles Belknap, U.S.N., was relieved from the command of the *Nero* at Manila by Lieut. Commander H. M. Hodges, U.S.N.

The expenses of this survey, so far as this Bureau is concerned, has been entirely defrayed from its current appropriations.

THE STEAM ENGINE FOR ELECTRIC TRACTION POWER HOUSES.

CONTINUING his article in the *Engineering Magazine*, Mr. C. A. Hague refers more especially to the larger sizes of plants. Engines of large size can, he says, be comfortably installed upon ground averaging as low as four-tenths of a square foot per horse-power, which may be compared with the 1½ to 2 square feet occupied by small plants. He lays stress on the economy thus secured in what Americans call real estate, in fine though unconscious irony in presence of the very unreal character of other estate which can well be contrasted with landed estate in being watered. We would not needlessly expend capital on land areas, but we think some kind of protest may very well be entered against the modern engineer whose one aim seems to be economy of land irrespective of the necessities of machinery. To this economy are due the many miserable electrical stations to be seen in this country, with boilers stowed away in a narrow house with no firing floor to speak of; engines crowded one upon another in rooms which render it impossible to pull out a piston without pulling the engine all apart; an entire absence of coal storage and a general lack of all design, traceable to the pernicious craze for cheapness of site and its natural corollary dearness of construction, maintenance, and working.

As an example of a large plant, the author cites one in progress that contains 11 cross-compound vertical engines direct connected to alternating current generators after the English system, which is gaining ground in America. The I.H.P. is to be 5,000 per set with a possible 7,000, the generators being alternators with revolving fields and external armature. Current is to be three-phase at 6,000 volts transformed down to 550 volts. It is doubtful if there is yet in this country any tramway system in which alternating currents and transformation can be applied with profit. The losses by the several transformations and the heavy outlay on machinery cannot fail to go a very long way towards paying for the cost of copper necessary in augmenting the conductor area for a direct 500-volt system. The three-phase system is no doubt perfectly legitimate where areas to be covered are of a sufficient extent, but the problem is worth very careful consideration, and in very large systems the expense of two stations of 20,000 H.P. will not of necessity exceed that of one station of 40,000 H.P. It is only small stations that are so costly to work when their absolute minimum of staff is still sufficient for a larger station. Large stations capable of utilising a full staff are not much cheapened in work by being further enlarged. It is a little surprising to find the author saying, in respect of water costs and surface condensers, that the necessary amount of courage has not yet been apparent to return this water with all its risks of cylinder oil, though so much money could be saved thereby. We believe that well-informed engineers are not afraid of saving and using the discharge of surface condensers, now that apparatus is procurable with which this can be satisfactorily cleansed of its oil.

What appears to be ancient history is that which tells how quite recently in America a quantity of belted machinery with intermediate countershafts was remodelled, with great saving of room. This double reduction belt-plant was put down less than 10 years ago.

Numerous illustrations are given of various large engines, some of which show the bolting together of the generator and fly-wheel so as to relieve shaft stresses. Finally, the author upholds the Corliss valve and trip gear, which has doubtless had great influence in America in keeping down the speeds of large engines to so very moderate a figure. If this is due to the valve gear, it is questionable if its choice has been so very wise after all, in spite of small clearance values secured by the Corliss valve.

OUR POSITION AS ENGINEERS.*

IN looking round for a subject upon which to address you this evening, I have been led to take one that I think is of supreme interest to us as engineers, and although it may not possess the merit of being pleasing, is yet one which, as members of this Association, and on the still higher ground, as members of the community, we ought to look fairly in the face and do all in our power to turn back the tide which threatens to overwhelm us.

The title I have given to my address is, for want of a better one, "Our Position as Engineers."

There is a saying, proverb, motto, or whatever you may prefer to call it, which at one time was practically, if not strictly, true, but to-day it is certainly *not* true. The saying I refer to is, "England the Workshop of the World."

It is true that our export trade in manufactured mechanical articles is still on the increase; but is the increase commensurate with the increase of the population of the world? This is probably a question that is not within the province or knowledge of anyone here to answer; but, allowing that it is, it is certainly not advancing at the same rate as the increased requirements of civilisation, and the opening of new sources of trade, together with the increase of the population and the greater numbers brought within the reach of civilisation.

We are forcibly reminded of this by the immense growth of the mechanical and industrial productions of foreign nations, notably America and Germany, and other countries in a lesser degree. The two countries (America and Germany) are not only large producers for home consumption (in this manner reducing their requirements from us), but they are also large suppliers to other countries, of which we at one time had the monopoly. This may not in itself be detrimental to us, and on the whole I do not think it has been, as it has undoubtedly been the means of stimulating healthy competition.

Prior to the great Exhibition of 1851, England was the world's provider in things mechanical. This Exhibition opened the eyes of the foreigners and set them on the *qui vive*, and from that time forth, in America and Germany and other countries, a mechanical spirit that threatens to overcome that of our own, has grown up. I am not prepared to say that the 1851 Exhibition (the first seed of what has been a pretty prolific family) was a mistake even from a national point of view, as I believe we have reaped benefits from it which are

* Inaugural address to the Manchester Association of Engineers by the President, Mr. Henry Hodgson, delivered Saturday, January 13th, 1900.

far in excess of any detriment that may have been caused to us from that event, although it, no doubt, was the stimulating cause of what has now grown into severe competition. We are all, of course, quite willing to admit in a general way that that must be right and best which does the most good to the greatest number, and we can all appreciate the force of this truth until it comes home to us individually.

The question which I draw your attention to is, In the race for the world's mechanical requirements, are we holding our own, and, if so, are we likely to continue to hold our own?

We do not want all the trade, for if we had all we could not execute it. Taking a backward view of the last 25 years, and more especially of the last 10, does the prospect before us hold out a hope that we shall maintain the foremost position in the race for the world's trade, if we continue on our present lines? We shall, no doubt, for some considerable time to come be the foremost, but we should not forget that, compared with any other country, we are largely industrial producers, whilst they, on the other hand, are largely engaged in agricultural production.

I am no pessimist, but I am of opinion that the condition of production will have to undergo considerable modification if we are to continue to hold the foremost place in the rank of the mechanical producers of the world. We have, within the last few years, had an invasion of mechanical work both from American and Germany, and, unfortunately, from our standpoint, there is a likelihood of this being continued. It may be said that this is only the natural outcome of the late lamentable strike in the engineering trade, and that when we have entirely recovered from the dislocation, affairs will return to their normal condition, and we shall supply our own requirements as heretofore. *Shall we?* Not unless we can, in the future, prevent any possibilities of strikes, and not until we re-organise our system of work. To the present we have been indulging in a spirit of self-sufficiency. The systems upon which we have been working, whilst they have served well in the past, have been, and are, too much stereotyped. We have been, and now are working too much on the lines of the gentleman who, having sons that appeared to him to have more go-aheadedness than discretion, stipulated in his will that the business was to be continued on the old lines, with the result that soon after his death there was no business to conduct.

Many of us have seen this same idea exemplified in the case of firms who, at one time, held foremost places in the engineering world, and whose business connections warranted the supposition that they were sound and safe as the Bank of England, but who, in consequence of holding on too long and too tenaciously to the system on which they had built up their reputation, gradually declined, and ultimately disappeared altogether. The old Lancashire saying that "there are only three generations from clogs to clogs" possesses, to my personal knowledge, and also, I have no doubt, to many of you, more than a substratum of truth. What is true of individuals is more or less true of communities.

The old and much of the present system will have to be largely modified if we are to maintain the leading position. One of the modifications, and a very important one, will have to be the relations between capital and labour; these ought, under no circumstances, to be antagonistic, and although at the present moment there is no open display, there is an undercurrent of antagonism which prevents workmen from doing all in their power to advance the interests of employers, which, in the long run, are also the interests of the workmen themselves. Man is a communist, and the success of one means, more or less, the success of many.

There seems to be an idea in the minds of many men, that the way to meet with continuous employment is to be careful not to do too much, this is one of the ideas of which their minds will require to be disabused. A better relation will have to be established between the employer and employé, by which the latter will only consider he has done his duty when he has done his best, and for which best he will in return reap a material pecuniary benefit.

Piecework, if it could be put on an equitable basis, and so formulated as to meet all cases, seems to me to promise a good measure of success, and in such work as lends itself to a fixed basis of prices, has proved fairly successful; but, unfortunately, there is a fly in the amber in this case. A rate or price is fixed for the production of a certain piece of work, the workman lays himself out to do his best, and in course of time becomes very expert, and earns a considerable sum weekly. Someone suddenly discovers this, and on the ground that he is earning too much, the price is cut down, not because the price paid per article is too much, but because the man has (even though it may be a natural consequence of intelligence and practice, and the use of small appliances of his own designing) largely increased his power of production. The effect of this is to prevent the man using his best endeavours in the future, and this is eventually to the detriment both of himself and his employer. This is not an isolated case, but is one of common occurrence in shops where repetition work only is the order of the day, and which must have the effect of neutralising to a large extent the advantage which piecework possesses if rightly administered.

There is another aspect of piecework, which, so far as I can judge, must somewhat militate against the system. This is a want of elasticity to meet the varying prices of the article manufactured. If a standard price exists for the construction of any article, there is not always a standard price for the sale of that article, and the price must necessarily ebb and flow according to the demand; the cost being a fixture, but the sale price a variable one, the employer is the one who has all the advantages and disadvantages of the varying prices. If the plus and minus balance each other, this may not be a very inequitable one, but the ups and downs may by no means be equal, and if the down grade should be one of considerable length disastrous results may be the consequence. It appears to me that in the case of such manufactures as admit of being worked upon the piece-work principle, the price paid for production should be governed directly by the price obtainable in the open market for the sale of the article so manufactured.

The piece-work system, however worked, does not meet the whole case of the relations between employer and employé between capital and labour. Some system more comprehensive will, sooner or later, have to be adopted (I think the sooner the better), by which the interest of the two shall be so bound together that the interest of one shall be *equally* the interest of the other. A system of industrial partnership appears to me to be the solution of the problem. In this partnership capital should have some fixed minimum rate of interest, and the workman a fixed minimum rate of wages, the profits resulting, after these have been met, being divided equally (or in some other proportion) between the two. This scheme might answer if profits were always certain. Of course, profits *ought* to be certain, and the absence of profits merely the result of accident. This difficulty would be met by not dividing all the profits when made, but keeping in hand some proportion to build up a reserve fund, from which the minimum interest on capital would be made a certainty in the time of the lean years. The workman's wages having been paid weekly, he would have nothing to receive at the end of the term, unless profits had been made, and I am inclined to believe that the incentive given by this method would be such as to ensure the desired result.

The idea may be deemed Utopian, and it may also be contended that it has been tried and has failed, and to the latter contention I am quite prepared to assent. I am also prepared to assert that in every age there has undoubtedly been someone who lived before his time, and further, that many failures do not necessarily prove a scheme to be unsound or impracticable. Failures may only prove that the conditions were not suitable, or that some leading factor has been omitted from the calculation. The industrial partnerships of the past have failed in most cases in consequence of the trade union factor being ignored, or not having been sufficiently allowed for. In many of the cases the scheme was inaugurated to get rid of the trades union factor, which in the long run proved too strong to be thus dealt with. The wisdom or folly of any such scheme cannot be tested by isolated cases, and the success or failure of any previous experiment cannot be taken as determining the ultimate result. The tendency of the times in several directions is, in my opinion, to bring this subject within the range of practical politics, and I am inclined to think that there are those present in this room who will live to see the idea put into practice in a more or less complete form.

Before I leave this subject I will mention what, to many of you will be common knowledge, that, at any rate, the rudiments of such a scheme is in operation in the manufactured iron and steel trades. The Cleveland district is more particularly the one I have in mind, but this, I believe, also prevails in the other iron and steel centres. It is well known that the makers' books are examined quarter by quarter to ascertain the selling price of each commodity, and from the prices so obtained an average is struck which regulates the prices to be paid to labour for the ensuing quarter. In this manner labour participates in the prosperity, and shares in the adversity of this branch of industry. I am not sufficiently acquainted with the inner workings of this arrangement to pronounce any judgment upon it, but it certainly appears to me to have the elements of a working scheme which can be applied to much more complicated businesses than that of the manufacture of iron and steel. The weakness of the arrangement, to my mind, is that it does not make the workman a participator in the profits, but only in the market price of the material, therefore it loses the inducement on the part of the workman to reduce the cost of production. It certainly has done *this* amount of good, that whilst before the scheme was inaugurated strikes were of frequent occurence, now they are practically a thing of the past, and, as a consequence, both capital and labour have reaped an immense advantage from the arrangement.

(To be continued.)

POSTAL CRITICS.

FOR the critic on the war-path there is no better target for his missiles than the Post Office. Far be it from us to declare that the postal administration is perfect, or to assert that criticism, when kept within proper limits, is unhealthy. But in its relations with the public the postal administration is frequently more sinned against than sinning. Having by means of criticism and legislation done its best to banish from the Post Office all volition, having left no room for the exercise of discretion, having in fact reduced the department as nearly as possible to the condition of a machine, the public then turns upon it and cries "Red tape!" when it carries out its functions with mechanical regularity. Forgetting that a large public organisation such as this must treat all men as equals, and, disregarding the inducements of profit-making, must do its utmost to render efficient service to the least of its clients, the public indignantly demands from it the mobility, the ductility, of a private business firm. The principles underlying the competitive private firm, which must, for its very existence' sake, trim its sails to every current of the financial air, are the principles which should be most persistently banished from a State business.

One of the latest postal critics is distinctly in a temper. Under the title of "Knots of Red Tape at the Post Office," the *St. James's Gazette* waxes wroth at some of the seeming anomalies of telegraph charges. The ground of the first charge is well chosen. Anyone who has even a nodding acquaintance with the German language knows that word combinations are more common in that language than in any other. The most elementary German Grammar will discourage the student who is inapt at word dissection. Three or four words—nay, whole phrases are commonly welded into one word. So our contemporary chooses the telegrams "made in Germany" in order to demonstrate the stupidity with which the English Post Office treats compound words. This is how the grievance is stated:—"According to the rule which obtains in Germany, the agent telegraphing to his principal will pay the charge for a single word only in respect of the words 'Dorset Square.'" There is a misstatement here to begin with. There is no rule, German or other, which makes "Dorset Square" one word. It is two, and should be charged as two by the German counter clerk. The critic then waxes very warm because the English Department collects 2d. surcharge on such a combination, and adduces in support the fact that we can send the "German equivalent of 'Dorset Square,' say 'Julichsplatz,' without paying for two words. Thus the Englishman pays 4d. for the two words 'Julichsplatz, Cologne,' in the address of his message, and when he gets a reply addressed to him at 'Grosvenor Place, London,' fully prepaid in Cologne, he has to pay a further 2d. in respect of the word 'place!'" As there is no clearing-house arrangement between the countries, and consequently England pockets the surcharges, our critic roundly accuses it of "slim"-ness. This is unfair. "Julichsplatz" is one word in German, and is accepted as one in England, "Grosvenor Place" is two words, and is only accepted as one in error by the German clerk. So the message sent to England is *not fully prepaid*, and the agent who imposes upon the German clerk's lack of knowledge of the English language is surely the "slim" person. Such imposition is persistently attempted, not only in addresses, but in the texts of telegrams, and unless the recipients were surcharged, and pressure thus brought to bear upon the senders of such combinations, they would grow to unmanageable dimensions. The occasional sender of a telegram whose correspondent is taxed for an error committed in good faith is really the victim, not of the English Post Office, but the "slim" agent who knowingly sends improper combinations to his principal. "Dorset Square" is two words in English as surely as "Boulevard Malesherbes" is two words in French, despite the fact that the usage of the German language makes "Julichsplatz" one.

"The whole method of dealing with double and compound words in telegrams in this country is," continues our contemporary, "in a truly parlous condition—a welter of confusion." Even were we to admit this, does the blame necessarily rest with the Post Office? The examples cited in support of this contention are too well-worn to require quotation in full. "Charing Cross" is two words, "Barton-in-the-Clay" is one. The anomaly is more apparent than real. If the critic of the *St. James's Gazette* would turn up his Hansard for April 4th, 1898, he would find a very full explanation there given by Mr. Hanbury in reply to Mr. Henniker-Heaton. "Why," asked the hero of Ocean Penny Postage, "why is 'Woodford Green' one, 'Charing Cross' two, and 'Newcastle-on-Tyne' one?" And he goes on to ask "whether he (Mr. Hanbury) will direct that clear and definite rules embodying one intelligible principle, shall be substituted for those on the subject in the 'Post Office Guide?'" Mr. Hanbury went to the root of the matter at once. "It is difficult," he said, "to say what are compound names, whether, for instance, his hon. friend would treat even his own name as one word or two." "Kentish Town and Charing Cross," continued the genial Secretary to the Treasury, "are charged as two words, while Woodford Green is charged as one, because like Newcastle-on-Tyne, it is a separate town or village, and neither of the other two places is." It was clear that without such a rule any group of houses might describe itself by a name as long as an ordinary sentence and claim that it should be treated as one word. The unkindest cut of all was when the hon. member for Canterbury was invited by Mr. Hanbury to suggest "any 'more intelligent principle' such as the question proposes," the Post Office would, he was sure, be glad of his assistance. That is practically the crux of this question of compound words: "Is there any intelligent principle which, whilst preventing abuse, will obviate all anomalies?" If so, the Post Office has, through the mouth of its representative in the House of Commons, invited suggestions.

The latest critic is on safer ground in his next grumble. He asks in effect that the same trouble should be taken to deliver a telegram as is now taken to deliver a letter. He must, however, make an allowance for speed. Letters insufficiently addressed are frequently some days, or even weeks, before they are triumphantly handed over to their rightful addressee. What would he say were a telegram thus treated? Is it not obviously a wiser course to return them promptly to the sender as undelivered, so that he may rectify the faulty address, and so secure the prompt delivery of what is, perhaps, an urgent message? So far as our contemporary objects to what looks like a deliberate attempt to force a registered address upon a firm so well known that registration is unnecessary, we agree with it. We are pleased to know that the postal authorities have, as far as possible, stopped such wilful obstruction to unregistered abbreviated addresses, and if our contemporary will make inquiries, it will find that the grounds of this plaint have practically been removed. Where such cases occur they are survivals which the Department is endeavouring to stop.

Do not let us be understood to be defending the whole of the principles of Postal Administration. We only wish to show that a knowledge of the real difficulties hedging round some of these apparent anomalies will put out of court the vituperation and charges of bad faith, "slim"-ness, and other sins in which our contemporary so glibly indulges. There are two sides to the question. When we detect any real endeavour by the Postal Telegraph Department to hamper the commerce of this country, we shall be among the first to expose it.

CONTINUOUS AND MULTIPHASE POWER PLANTS FOR FACTORY USE.

[COMMUNICATED.]

A GOOD deal has been written, and still more said, about the advantages of multiphase over continuous current power plants, the latter being the most usual in this country. We have also heard from the lips of the President of our Institution, Prof. S. P. Thompson, that continuous current motors are doomed, and will drop out of use within the next few years.

It is therefore both interesting and instructive at this present moment to see what actually has been done, and is likely to be done, in the near future in the way of multiphase machinery to replace the continuous current power plants.

In the first place it must be quite evident to everyone interested in the subject, that multiphase motors will work, and further, that the torque obtainable at starting is greater than was originally supposed, which enables them to start up without difficulty against reasonable loads.

Further, this being the case, opportunities will no doubt crop up where the use of multiphase motors for transmission schemes will be a convenience, thereby saving rotary converters. It is, however, on long transmission lines that multiphase motor plants display greater advantages than they do in the ordinary factory, shipyard, iron and steel works, and the single advantage named above, of being able to dispense with rotary converters, will go some way towards eliminating certain disadvantages introduced by the multiphase motor, which are dealt with later on.

That multiphase motors are, however, at present not quite ready to meet the demand, seems evident from the fact that in equipping the New York Elevated Railway, the Westinghouse Company are generating three-phase, and converting to continuous current for the motors. This can be taken as representing the latest practice in the States.

When one comes, however, to ordinary factory driving, such as one meets in iron and steel works, shipyards, and

engineers' shops in this country—establishments which almost always have generating plants of their own—it is extremely difficult to see, after weighing the *pros* and *cons* of each case together, where the advantage of the multiphase system comes in.

One is always rather liable to think that ideas and systems originated abroad, and which have possibly been put to some practical use, are necessarily superior to our own systems and methods, and this, coupled with the wish to be the first to introduce a new system into our own country, may to some extent be responsible for the opinions of some of our engineers in favour of multiphase motors.

Prof. Thompson and other engineers came back from the Swiss tour this summer with the idea that there was nothing to touch the multiphase motor. On trying to ascertain the cause of this opinion, the advantages claimed for it, so far as the writer can make out, resolve themselves into the following :—

1. Probably somewhat cheaper in prime cost, size for size.

2. Due to the absence of a commutator, the maintenance cost of motors, as well as generators, may be somewhat smaller than that of continuous current machinery.

3. The starting and switching arrangements are undoubtedly somewhat simpler, and both the prime cost and maintenance cost of same will be less than with a continuous current starter, which is always liable to spark and deteriorate.

On the other hand, however, the disadvantages of multiphase motors are not to be ignored from the point of view of the works' manager who has to use them.

Some of the difficulties met with in multiphase power plants are the following :—

1. The starting torque is poor compared with that of a continuous current motor; and, although theoretically the maximum torque can be obtained at starting (by the introduction of resistances into the rotor circuit at the moment of starting), yet practically the torque often required at starting, and at stages during actual working for a great many tools fitted with separate motors, very much exceeds this normal torque, and cannot be dealt with excepting by the use of an abnormally large motor.

The writer knows of a good many continuous current motors which have had to be overloaded between 25 per cent. and 50 per cent. for several hours at a time, and, in addition to this, to be capable of dealing with momentary overloads amounting to about 150 per cent. over the normal load. This continual overloading of a continuous current motor is not desirable from the point of view of wear and tear, yet it is possible, and often a convenience.

With a multiphase motor, one is given to understand that this is impossible, and consequently a larger size of motor has to be used to be capable of dealing with the momentary overloads, which means that this larger motor will be run for the greater part of its time at perhaps one-third or half its full load, which, from the point of view of efficiency and prime cost, is not desirable.

In other words, in deciding what size of multiphase motor to use to drive a tool, one has to be guided by the peak of the power curve, whereas with the continuous current motor one would look at the average height of the power curve, and rely on the "overloading power" of the motor to carry one over the peaks.

Then again, it should be borne in mind that the continuous current commutator, with carbon brushes, will not give as much trouble as is often made out, if the motor is not heavily overloaded—it is when the motor is considerably overloaded that sparking and wear and tear of brushes and commutator commence. If one is going to compare the wear and tear of a multiphase motor with that of a continuous current motor, one should run the latter under the same conditions, which usually means considerably underloaded.

2. The use of three or more wires to each motor in a factory, in place of two, is a disadvantage.

3. The impossibility of regulating the speed of a multiphase motor to a nicety is very objectionable from a practical point of view, and the continuous current motor in fighting its way against the old methods of driving has been able to emphasise this point to great advantage.

4. Finally, the difficulty of getting readings of what a motor is actually doing—with anything like a shop instrument—will be felt.

One advantage of continuous current distribution for motor work is, that one knows exactly where one's power is going to, and how much each tool or line of shafting consumes.

The difficulty, however, of taking rough readings in the shop with the multiphase system means that, in the majority of cases, the readings will most probably not be taken.

In short, the multiphase system does not seem so accommodating and flexible for power work as the continuous current system.

The writer started some time ago, with a perfectly unbiassed mind, to find out about, and in certain cases to inspect, some of the multiphase plants put down in this country. In short, to answer the question to his own satisfaction, whether the multiphase system had points which could not be touched with the continuous current system, and if so, what these points were.

He had the privilege of inspecting a large motor plant on the two-phase system, put down in the North of England in some steel works, by an engineer who had had considerable experience in driving the class of tool met with in similar works by continuous currents.

He was informed by the general manager that the complete plant was now giving the utmost satisfaction, although in the first case the rotor of almost every motor had burnt up, due to provision not having been made for the temporary overloads, which this class of tool necessitates.

The original motors were discarded, and others of double the power were substituted, which are now giving every satisfaction, although working, it should be noted, *as a rule*, well below their normal load.

It is only when the heaviest load comes on, momentarily, that the motors are fully loaded. *Four* cables were run to each motor (although the two inner ones were combined in one for some of the spans); it has since been found necessary to duplicate the cables to transmit more power, hence we have *eight* cables about the works.

The conclusion the writer came to, after inspecting the motors at work, and watching the loads very carefully as they suddenly came on and off, was that although the plant was no doubt doing all that the general manager claimed for it in the way of effecting great economies over the old system of driving, yet this plant was doing nothing that an ordinary continuous current plant would not do, whilst it did not possess the flexibility and certain advantages in small details which the continuous current plant would have had.

The motors required quite as much attention as continuous current motors would have required, which, after all, only amounts to filling up the oil chambers with oil—say, once a week—and cleaning down the machine with a piece of waste. In addition to this, a continuous current motor would only have required its commutator wiping over, and occasionally cleaning with a piece of emery paper.

The writer has since been given to understand that the engineer responsible for this plant does not contemplate putting down further multiphase plants for work of this description.

Another plant on the multiphase system put down in this country is for driving a cutlery factory in the Midlands. The writer was not allowed admission, being told by the head of the firm that the system of motor driving had been so carefully thought out, that they were not disposed to give it away, and from what the writer has heard from those that have seen the plant, this accounts no doubt for the fact that the chief motor is situated in the engine room, driving a length of shafting, which is brought to it through the engine room wall. A number of other motors are spread about the works. The writer is, however, given to understand that nothing is gained here by using multiphase motors, whilst, on the other hand, the objections already pointed out are present.

Another plant on the multiphase system has been put down in the West of England for driving some heavy engineering shops, and the writer had the privilege of inspecting this plant. There are about 10 multiphase motors at work, the majority driving long lengths of shafting and countershafting, &c., which enabled the motors to start up on a fairly light load, as the tools would be running light at first.

There appeared to be no points in favour of multiphase working, and although the authorities seemed perfectly satisfied with the results they were obtaining, it is quite certain that they would have obtained equally good results with a continuous current system of driving.

There were big savings to be made over the whole system of driving, and *any* system of motor driving would have saved them.

At first the writer was full of hope at seeing in the engine house a large name plate, measuring about 10 feet × 1 foot 6 inches, bearing the contractor's name; after this he felt sure there would be something worth seeing, and to be learnt from the multiphase system, but the system of driving did not warrant this hope, nor yet did the enclosed arc lighting adopted through the shops.

Enclosed arc lighting for any shops is bad enough, but when it comes to alternating enclosed lamps, and for foundry lighting, the system is sure to be a failure for want of sufficient light.

It should not be forgotten that the manufacturing concerns, both in America and on the Continent, are fewer in number, but more powerful, individually, than our own.

Consequently, when one of these large concerns becomes interested in any special patent, it is in a better position to introduce and push that system (although possibly its merits might not warrant it) than any of our own manufacturers would be; and further, the favourable influence radiating from any of these large engineering concerns is bound to make itself felt, and, to some extent, respected.

Before deciding for ourselves, however, as to the value of any system, it is important that we should make allowance for the commercial interest our American and Continental friends have in their own systems, which accounts no doubt largely for the number of multiphase plants met with abroad.

On the Continent the leading manufacturers act largely as the consulting engineers, and their advice is taken without any further questioning; consequently, if they are interested in one system, for which they hold perhaps the master patents, they will advocate it, and try to get the system universally adopted.

In conclusion, it should, however, be pointed out that possibly our multiphase friends abroad have more up their sleeve than they will divulge, and also that their make of motor is superior to the ones made in this country, to which the above descriptions refer.

If this is, however, not the case, it is very difficult to understand, unless it be a transmission job, where the advantages of the multiphase system comes in.

ELECTRIC MOTOR CARS.

THERE is probably no application of electricity full of greater promise than that of motor cars, and probably in no direction has greater disappointment been experienced. In spite of the many failures, however, there has been a constantly growing interest in electric motor cars, and great activity is being displayed on all hands by inventors. Without for a moment wishing to decry the efforts to introduce electric motor cars in this country, it certainly does appear as if greater success had been achieved both in the United States and in France.

But even in these two countries there is a certain amount of difficulty in obtaining authentic information as to the working results. Detailed descriptions are plentiful, but when we come to the important question of maintenance, there is little or no information forthcoming. A recent issue of the *Electrical World* contains a most interesting account of what is termed an electrical automobile system which has been in use for some time at Newport, R.I. Some portions of this description are of extreme interest, on account of the carefully planned details of a motor car system, and the possibility of an electric carriage company doing business with the hiring out of vehicles. It appears that this company started business with the idea of supplying a summer population with automobiles, and though there must have been a certain amount of trouble in instructing the persons who hired such vehicles, it is a remarkable fact that although the greater part of the vehicles were not operated by the company's servants, very few accidents had been recorded. During last summer the company had some 20 carriages in operation, and for the whole of the season they were in use.

The following method of dealing with the carriages was adopted:—When the carriages were brought in for the night they were immediately washed, sponged, chamoised, and polished by their dryers. The carriage was then run to its night berth for inspection and charging, but before being charged the rear axle was jacked up, both rear wheels taken off, and both balls and cones examined before the wheels were returned. Commutators and brushes were examined and cleaned, and all bearings inspected and oiled. The combination meter was examined while wheels were being run clear of the floor, to see if the normal amount of power was being consumed, and the brake tried to see if both wheels worked together; the gong and lamps were overhauled, jacks removed from the rear axles, and charging plug inserted, and the steering gear was tried and examined. When fully charged, a large card with the word "Charged" was placed on the carriage in a conspicuous place, and in the early morning the tyres were inflated while the carriage was still in its night berth. A running test of the brakes was made in the yard, and the "Charged" card reversed, showing the word "Ready." It might appear, of course, that such an undertaking would prove a most laborious one, but although probably an electric motor car might require a little more detailed attention than a horse and vehicle, it must not be forgotten that if the whole of the vehicles of this company had been drawn by horses, it would have required a considerable staff of ostlers and stable-men to attend to the requirements of the horses. Apparently carriages were sent out early in the morning, and probably were not returned until late at night.

Quite early in its operations the company was confronted by two serious difficulties. The pumping of the wheel tyres by hand cost some $2.40 per day, or $676 per year for air. This expense was quickly disposed of by installing a large electric motor connected by a belt to a Knowles air compressor. The need was also felt for some cheap device for taking the batteries out of the carriage body and returning them again. It was found that the trouble with most devices of this character was either in high investment cost, or in the difficulty in getting the changing apparatus into the carriage and round the battery, unless a design were adopted which could handle the entire weight of the carriage, and this would cost far beyond what a small plant could afford.

The result of the investigations of the managers was the building of a special truck with broad wheels and a swivel in front. On the top of this truck was placed a turn-table, which would exactly meet any angle of the carriage. On the turn-table were mounted rollers, and a drawing apparatus, which consisted of a bicycle chain having on the end a snap, which connected on to a hitching ring screwed on the front of the battery boxes. The upper end of the chain was made fast to a simple positive clutch, mounted on a hand-rotated shaft. These clutches were thrown in or out, as one or more of the four battery boxes needed to be withdrawn. To accommodate the varying height of a motor car or the mounting of the carriage springs, which altered as each battery box was withdrawn, a lever was placed under the turn-table, which by means of a hand screw on the rear of the truck was raised or lowered, which in turn moved the front of the turn-table up or down. The side motion of the turn-table was effected in the same manner but by a lighter screw. As the truck was portable, it was possible to withdraw the battery from the carriage in any convenient place and move the cells away for charging. The batteries were returned to the carriage by simply pushing them back by hand, aided by the slight angle of the top truck.

Quite an elaborate system prevailed regarding repairs, and in order to ascertain the exact cost of different repair operations and renewals, a series of time cards was used, each containing the date, style, and number of the carriage, the part repaired, what was done to it, the material used, and, if possible, the cause of the trouble and the condition of the part before it was repaired. On the back of this the one or more workmen who worked on the repairs signed their names, and put opposite the time they started and the time they stopped.

From the illustrations which accompany the article there are improvements effected, but for the most part we are fain to admit that they emphasise the absence of the horse. Apparently the vehicles of this company were subjected to a certain amount of rough usage, for vehicles designed to accommodate four people were frequently made to carry 10. These vehicles weighed 2,500 lbs., had a speed of 10 miles per hour, and a record mileage of 37 miles level. Although vehicles of other designs were used, there was no very serious difference in the weight, and the mileage was about the same. Though it is regrettable that no data accompany the article as to the cost of operation, it is worth quoting the writer's brief account of what the vehicles had to suffer. Among some of the accomplishments of customers were the putting in of a safety plug when the amateur driver had placed the controller on the full speed notch, with the result that the automobile nearly went through the side of a barn. Again, while at a picnic, one of the customers, for some reason or other which is not explained, ran one of the motors through a huge bonfire. Another inventive genius raced downhill backwards, and while going 20 miles an hour, reversed his motor, with the result of making the carriage turn a complete somersault. Whether the driver was satisfied with his achievement the writer does not say. Another driver became confused in going up a sharp incline, and jumped from the car without taking out the safety plug. As he jumped, his coat caught on the safety lever, and started the machine ahead at full speed. The car first rammed Mr. Vanderbilt's steam carriage; having disposed of its steam rival, it made for Mr. Winthrop's gasolene machine, which it just grazed, and ended its career by going down 11 stone steps to the wine cellar of the golf club, which is proof that the car knew what it wanted. It took three hours to get this machine above ground, yet, apart from the repairs to the dashboard, it was ready to go into commission in an hour, which shows the sound quality of the golf club's wines. The writer in our contemporary also states that frequently the emergency wagon was called out by a carriage that was supposed to be disabled. On arriving upon the scene, after, perhaps, a mile run, it was found that the customer had forgotten to put in his emergency plug. On the other hand, it is certainly to the credit of these same customers that not one horse was caused to run away during the whole of the season. In the same journal an account is given of what is termed a record-making automobile, and the performance of this motor is certainly a remarkable one. The vehicle was one of the Electric Vehicle Company's Columbia vehicles, and the storage battery was made by the Electric Storage Battery Company. The object to be achieved was to determine the governing factors in the construction of a storage battery, motor, tyres, bearings, and running gear construction for a light long-distance automobile. The front wheels were 32 inches diameter, and the rear 36 inches, and solid rubber tyres were employed. On the subject of tyres it is worth relating that an electric vehicle has been running in and round London for some nine months, and the tyres, which are of the solid type, have not been renewed. Assuming that the springs of a vehicle are good, better results should be obtained with solid, rather than with pneumatic tyres, and there are certainly fewer chances of anything going wrong.

In the record-making car alluded to one motor was employed, which drove the wheels through single reduction gear, the capacity of the motor being 25 amperes at 80 volts, and 1,000 revolutions per minute. The total weight of the vehicle, with battery, was 2,180 lbs., the battery weighing 980 lbs. The controller gave three speeds ahead, and two backwards. Instruments for taking the readings were provided. The battery consisted of 48 cells, mounted in four separate boxes of 12 cells, each cell containing 11 plates. The capacity of the battery when discharged at 22-ampere rate was 150 ampere-hours. It is unnecessary to give the whole details of the run, but it may be mentioned that the time of starting was 11.41 a.m., and that at the end of 22 miles the time was 1.29.22, the voltage at 22 amperes discharge was 97, and the kilowatt-hour expenditure 3·7. At the end of the 60th mile the time was 5.45 p.m., the voltage reading was 95, at 22 amperes discharge, and the watt-hour expenditure 2·65 KW.-hours. The total time travelling in one direction, from the Ferry in Camden to Atlantic City, was 6 hours and 4 minutes, and the total distance traversed was 68·57 miles. The total expenditure of energy was 9·17 KW.-hours. The ampere-hour efficiency of the battery was taken at 86 per cent. and the average charging voltage 110. The total KW.-hours necessary to purchase to make the run were 12·3, and at 3d. per KW.-hour, the price paid in Atlantic City and Philadelphia, the cost amounted to 36·7d., or a little over ½d. per mile. Further trials followed on the next day, the battery and carriage receiving no attention in the meantime, until a distance of 96 miles had been accomplished, when the battery was re-charged. The condensed data for the 100 miles are as follows:—

Total distance travelled	**100 miles.**
Total time consumed	**7 hours 45 min.**
Average speed in miles per hour	**12·9.**
Voltage just before finishing 100th mile ...	**78 at 22 amperes.**
Total KW.-hours expended	**13·6.**
Total KW.-hours of charge	**20 9.**
Cost of charge at 6 cents per KW.-hour ...	**$1.25.**
Cost per mile	**1¼ cent.**

The best previous record for an electric automobile on one charge of the storage battery was 136 kilometres, or 84·4 miles, at an average speed of 11·6 miles per hour. The weight of the battery was 2,000 lbs.

There is no doubt that the motor car accomplished a very fine performance, and if it had not been somewhat spoilt by collisions a much better speed would have been attained, as is evidenced by the fact that five miles were covered in one instance in 22 minutes and 30 seconds, and another five miles were actually covered in 14 minutes 49 seconds. It was not surprising that at such an excessive rate of travelling a collision should have occurred, and the drivers of the car are to be congratulated that they were not driving through Surrey. Such data are of course of extreme interest to all who are working on the subject of electric motor cars, and if they could be amplified with figures regarding cost of upkeep a very vexed question would be settled.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

4,931A. "Improvements in and connected with telegraphy." W. L. WISE. (A. C. Crehore and G. O. Squier, United States.) Dated January 8th. (Date claimed under Patents Rule 19, March 6th, 1899.)

420. "Improvements in electric arc lamps." H. BREMER. Dated January 8th. (Complete.)

434. "Improvements in and pertaining to phonographs, gramophones, telephones, and the like." A. S. BOWLEY. Dated January 8th.

435. "Improvements in apparatus for electrically interlocking the doors or gates with the operative machinery of hydraulic or other lifts." F. T. HOLLINS and H. C. T. AMENDT. Dated January 8th.

440. "Improvements in electric light sockets." L. M. CHAPMAN and J. M. GELATT. Dated January 8th.

463. "Improvements in electrical switches." W. L. WISE. (The Aktien Gesellschaft Elektricitäts-werke vorm. O. L. Kummer & Co., Germany.) Dated January 8th.

466. "Improvements in apparatus for facilitating the escape of gas from electric storage batteries or accumulators." W. J. WELLS and ALLAN and ADAMSON, LIMITED. Dated January 8th.

467. "Improvements in or relating to electric light fittings." B. M. FLETCHER. Dated January 8th.

489. "Improvements in devices for locating earth contacts on electric circuits." M. J. MYERS. Dated January 9th. (Complete.)

507. "Improvements in the construction and manufacture of electric bells." A. CLARKE. Dated January 9th.

516. "Improved electric switch for electric trams and railways." J. VESELY. Dated January 9th. (Complete.)

524. "Improvements in and relating to variable electrical resistances." E. A. GODDIN and J. T. ARMSTRONG. Dated January 9th.

547. "Improvements in process of and apparatus for magnetic separation." C. Q. PAYNE. Dated January 9th. (Complete.)

559. "Improvements in transformers." W. L. WISE. (The Aktien Gesellschaft Elektricitäts-werke vorm. O. L. Kummer & Co., Germany.) Dated January 9th.

565. "Improvements in and or connected with electric meters." J. G. LORRAIN. (H. A. Macdonald, France.) Dated January 9th.

591. "Improved apparatus for regulating the current in an electrolytic interrupter." L. N. TYACK and F. B. FAWCETT. Dated January 10th.

595. "New process of total suppression of motive power as well as of electric energy in the industrial production of carbides." J. DE BURGUE and R. SUNYE. Dated January 10th.

610. "Improvements in electric order telegraphs for use on shipboard and elsewhere." C. F. KRONHEIMER. Dated January 10th.

622. "Improvements in incandescent, arc and other lamps." E. BONHIVERS. Dated January 10th. (Complete.)

623. "Improved carriers for wires or electric conductors, such as the trolley wires or conductors of electric railways, tramways, and the like." R. F. BLACK. Dated January 10th.

630. "A method of and apparatus for connecting electric meters in three-wire circuits." J. R. DICK and THE REASON MANUFACTURING COMPANY. Dated January 10th.

686. "Improvements in screens for incandescent electric lamps." H. SIMPSON. Dated January 11th.

688. "Improved electrode." E. A. LE SUEUR. Dated January 11th.

665. "Improvements in or connected with electrically actuated mechanism applicable for various purposes, such as the steering of ships, the working of engine room or like telegraphs, or the training of guns." G. E. VAUGHAN. (J. A. Vaughan, South Africa.) Dated January 11th.

659. "Improvements in electric switches." A. GARDY. Dated January 11th.

661. "Improvements in telephone apparatus." W. MOSELEY. Dated January 11th.

675. "Improvements in or relating to electric batteries." H. H. LAKE. (R. C. McCartney, United States.) Dated January 11th. (Complete.)

683. "Alternating current meter for small non-inductive charges." V. I. FERNY. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated January 11th. (Complete.)

695. "Improvements in magnetic cut-outs." E. ANDREAS. Dated January 11th.

700. "Improvements in compounds for di-electrical purposes." C. JUNG, A. BRECHER and A. KITTEL. Dated January 11th.

739. "Improvements in electrical switches." C. M. DORMAN, R. A. SMITH and H. G. BAGGS. Dated January 12th. (Complete.)

750. "Improvements in and relating to dynamometers." F. J. COX. Dated January 12th.

758. "Improvements in controlling devices for the motor circuits of electrically propelled vehicles." J. WETTER. (The Elektricitäts Aktien Gesellschaft vormals Schuckert & Co., Germany.) Dated January 12th.

768. "Improvements in or connected with electric arc lamps." THE DAVY ELECTRICAL CONSTRUCTION CO., LTD., and J. L. E. DANIEL. Dated January 12th.

776. "Improvements in electric fittings." A. E. BENNETT. Dated January 12th.

813. "Improvements in the manufacture of accumulator plates." Z. STANECKI. Dated January 13th. (Complete.)

814. "Improved method of and installation for operating two-phase electric motors." B. G. LAMME. Dated January 13th. (Date applied for under Patents, &c., Act, 1883, Section 103, June 14th, 1899, being date of application in U.S.).

837. "Improvements in or relating to incandescence electric lamps." H. H. LAKE. (T. Shearman, U.S.) Dated January 13th. (Complete.)

838. "Improvements in or relating to incandescence electric lamps." H. H. LAKE. (T. Shearman, U.S.) Dated January 13th. (Complete.)

839. "Improvements in or relating to incandescence electric lamps." H. H. LAKE. (T. Shearman, U.S.). Dated January 13th. (Complete.)

840. "Improvements in or relating to incandescence electric lamps." H. H. LAKE. (L. Shearman, United States.) Dated January 13th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

4,934. "Improvements in electric arc lamps." H. Delavau. Dated February 23rd, 1897. Arc lamps are constructed with flat supply chambers, each holding a row of carbons, and with clutch mechanisms for feeding these automatically. Each carbon is pointed at one end and recessed at the other to fit the corresponding parts of those preceding and following it to the arc. The carbons in the chambers are moved towards their outer sides by pressers actuated by springs. The outer carbons are drawn downwards by intermittently-acting clutches. Each clutch consists of two jaws on inclined rods which are held up by surrounding springs; the jaws are linked to an adjusting nut on a hollow movable core in a solenoid through which the carbon passes. The lamp being in circuit, current passes directly from one thermal to the other through a spring-held armature, a contact, and a high resistance electro-magnet. When the difference of potential is sufficient to cause the magnet to lift the armature, contact is made. Current then passes by the armature and contact through the two solenoids, each solenoid then draws down its core, closing the jaws on the carbon and drawing it down until the breaking of contact allows the jaws to open again. The main current passes to the carbons by the chambers which are insulated, and through two other solenoids operates a movable core and jaws similar to those acting on the carbon to strike the arc on starting and keep it of proper length. An ash receptacle is provided. A marble and asbestos stop fixed below the carbon points supports them when the lamp is not in operation. 6 claims.

4,993. "Improvements in apparatus for automatically cutting out electrical currents from dynamos when rising above or falling below a determined maximum or minimum, and for gradually turning on such currents." E. L. Joseph. Dated February 24th, 1897. Consists of a combined cut-out and switch arrangement for use in dynamo circuits for charging accumulators, &c., by means of which the circuit is automatically broken when the strength of the current rises above a certain maximum or when it falls below a certain minimum; at the same time provision may be made for turning on the current gradually. 3 claims.

5,568. "Improved construction of asynchronous motor for single or polyphase alternating electrical currents in combination with an auxiliary synchronous motor." C. D. Abel. Dated March 2nd, 1897. An asynchronous motor for utilising monophase or polyphase alternating currents is combined with an auxiliary synchronous motor. The stationary induced part of the asynchronous motor is wound with four coils which are closed respectively upon a corresponding number of coils on the stationary armature of the synchronous motor. The revolving inducing part of the asynchronous motor is wound with coils so as to produce two opposite poles, and these coils are connected with the working circuit through contact rings and brushes. The inducer or field-magnet of the synchronous motor is furnished with a winding capable of being connected with a continuous current supply, and carries an annular conducting screen which opposes any variation of magnetic flux. When the inducing circuit of the asynchronous motor is supplied with alternating currents, it acts first as a transformer and supplies the armature of the synchronous motor with currents which cause it to start and run up to a speed very near synchronism. On supplying the inducer of the synchronous motor with a continuous current, the asynchronous motor will be automatically started. Resistances are inserted between the two motors at starting, and are afterwards cut out. When monophase currents are supplied to the asynchronous motor, the synchronous motor must be started either by hand or by providing it with two starting circuits, one containing a self-induction coil or condenser and the other a resistance. 2 claims.

6,868. "Improvements in electric arc lamps." T. E. Adams. Dated March 16th, 1897. A clutch lamp with the arc enclosed in a small globe is provided with a series electro-magnet arranged to strike and maintain a long arc, and having a nearly closed iron magnetic circuit to economise power. The upper carbon is carried by an insulated arm of a blade and falls by its weight under control of a clutch of any ordinary construction. The clutch is connected by a rod with an arm of an L-shaped armature which turns on the lower pole of the magnet; the free upturned end of the armature is situated near an extension from the upper pole so that when the magnet is excited the armature passes under this extension. The opposed surfaces of the magnet and armature are of considerable area. Hooks on the magnet poles support the armature when the magnet is inactive. The upper hook supports an air pot in which a plunger carried by the arm of the armature operates to moderate its motion. All these parts are supported by bolting the magnet to the top of a casing. This is closed by a bottom plate which carries the outer globe holding arm. The top and bottom carry insulated plates, connected by a tube and a rod, which with the arm form guides for rollers on the clutch-blade to guide the upper carbon. The outer globe with a light cover is supported by packing between discs screwed on a sleeve. This sleeve slides upon a tube secured in the arm and is supported by a nut thereon. The nut is connected with a rod and a surrounding tube having projecting parts within the tube to support the globe in a lower position when the nut has been removed from the tube. The inner globe is held by a thimble and spring against a thin metal cover secured by a screw on a rod, which is fixed in the tube. The upper carbon slides through a plug screwed into the cover. The lower carbon is held in a clamp consisting of two curved pieces, one fixed on a rod and the other held by a screw and pins, electric connection being made by the rods with the plate which carries a binding screw. The upper carbon holder is connected by a flexible lead with the magnet, an adjustable resistance and a hand switch which projects from the casing and serves to make connection with a second terminal plate. The resistance is a wire helix passed through a number of short cylindrical insulators surrounding a ring. A metal block clamped in the helix by a screw and washer gripping the wire, is connected by a flexible conductor insulated with asbestos to one of the terminals of the resistance to short-circuit more or less of it. The resistance is covered by caps which are separated by lugs permiting ventilation. 20 claims.

7,235. "Improvements in switching apparatus more especially adapted for use with electrical motors." H. Edmunds. Dated March 19th, 1897. In switches for controlling motors the contact arm is operated through worm gearing to make contact, and a quick break is given by a spring or weight. The contact arm which moves over a series of contacts for first closing the field circuit and afterwards the armature circuit through suitable resistances, is mounted on a spindle on which a worm wheel is also fixed. This wheel is operated by a worm mounted in a pivoted carrier bracket, and normally held out of gear by a spring. On pressing down the rod the gearing engages and the contact arm can be moved. When the switch is fully on a magnet is energised and holds down the bearing frame, so maintaining the switch in position. Should the current fail the bearing frame is no longer held down and the spring causes a quick break. 5 claims.

7,373. "Improvements in the apparatus for controlling the action of electric motors at a distance." W. Smith and G. E. Elphinstone. Dated March 22nd, 1897. Apparatus for controlling the action of motors at a distance and for indicating at the transmitting end that the work has been properly performed. Preferably the motor whose action is to be controlled constantly rotates, and is put into gear with mechanism by electro-magnetic clutches operated from the transmitter. Or in a modified arrangement the current may be arranged to start the motor. The apparatus is applicable for steering gear, searchlights, elevating guns, &c. The shaft driven by worm gearing from the handle carries a bevel wheel gearing with the wheel loose on its spindle, which is carried by a casting loose on the shaft, which gears with another wheel loose on the shaft. Movements of the shaft are indicated by a pointer. The casting carries two cams adapted to engage switch arms. One cam operates one arm when the shaft is turned in one direction, and the other cam operates the other when the shaft turns in the opposite. These switches are connected in the electro-magnet clutches at the receiving mechanism, and so determines the direction of rotation of such mechanism. A drum switch at the receiver sends back, when the mechanism is working, an intermittent current to the magnets oscillating its armature, allowing the wheel under the action of a spring to rotate and bring back the casting with its cams to the position of rest, this being indicated by the pointer. At the same time the contact is broken and the clutch at the receiver is released. Electro-magnetic means are provided at the receiver to prevent the rotating shaft from overshooting when the clutch is released. A shaft, controlled by a pin, is arranged at the transmitter to prevent movement of the handle when the instruments are not in the right position. 5 claims.

7,532. "Improvements in the combined electrolytic and leaching treatment of zinc-bearing ores and products." E. A. Ashcroft. Dated March 23rd, 1897. Relates to the process for the combined leaching and electrolysing of zinc ores and other zinc products described in Specifications No. 13,850, A.D. 1894, and No. 13,534, A.D. 1895. Consists essentially in employing insoluble (*e.g.* carbon), anodes instead of iron ones. The zinc chloride solution from the leaching vats enters the cathode compartment where metallic zinc is deposited. The weakened solution passes away, mixes with ferrous chloride or sulphate solution, and enters the anode compartment having a carbon anode. Here the ferrous solution is peroxidised. A portion, namely, one-third the solution, is withdrawn and passes to the leaching vats for extracting fresh zinc to obtain the solution for use in the cathode compartment, while the bulk passes to a vat containing scrap or other cheap form of iron, whereby it is reduced to the ferrous condition, and is then led back to the anode compartment. Polarisation is prevented by the presence of ferrous salts in the anode compartments. 3 claims.

7,645. "Improved means for preventing installations for electrical transmission of energy, in particular electric railways, from causing disturbances in telephonic circuits." Siemens Bros. & Co., Ltd. Dated March 24th, 1897. Relates to means for minimising disturbance in adjacent telephone circuits in installations worked by continuous currents, such as electric railways. Self-induction coils are arranged on the cars and also in the feeders. Instead of having induction coils on the cars (or in order to reduce their size) the feeders may be divided into sections and self-induction coils be inserted in each section (or only in the sections near the telephone circuits), near the points of consumption. In certain cases in which accumulators are employed and charged during the running, the choking coils are placed in the common circuit of the motor and and accumulator, or the field coils of the motors may be employed, suitable coils being wound on the magnet limbs and suitably connected to the battery. In other arrangements choking coils are used in connection with condensers arranged in parallel with the motors. 7 claims.

7,772. "Improvements in alternating current motors." W. Langdon-Davies. Dated March 25th, 1897. Relates to controlling motors. The stationary windings to which alternating current is supplied in a single-phase induction motor, are modified to facilitate starting. The ordinary running coils are conducted to terminals, and are supplied with current either directly or through a starting resistance by a switch. In the starting position this switch also supplies current in parallel through a terminal to starting coils of many turns of fine wire, set at angles to the main coils; the inductance of the starting coils alters the phase of the current in them relatively to that of the current in the circuit, so as to produce a starting torque. In another arrangement, the main running coils are wound with two or more wires, which are connected in series for starting, or in parallel for running, directly on the mains, by a suitable switch; the starting coils are of thick wire, and a resistance is used in series with them. 2 claims.

7,774. "Improvements in selective signal apparatus for party telephone lines." J. E. Kingsbury. Dated March 25th, 1897. An exchange system is described, in which not more than 12 sub-stations are connected between two wires from the exchange; any one can be called separately from the exchange. If not more than two sub-stations are connected to each pair of wires, means can be provided for locking all the instruments at the sub-stations, except one called, so that interruption of communication with this one by the others is made impossible. The diagram shows the connections of one sub-station between the wires, and an annunciator at the exchange. The arrangement of connections, &c., between the sub-stations and exchange are shown in diagrams too complicated for purposes of abridgment. 18 claims.

7,823. "Improvements in electric switches." E. W. Cowan and A. Still. Dated March 26th, 1897. Switches for circuits having considerable self-induction, such as the fields of dynamos, motors, &c. To prevent sparking, &c., a resistance is first inserted in series with the circuit, which is then short-circuited, and finally the supply disconnected. To break the circuit, the handle is pulled over, the first effect being to remove the lever from the contacts, so inserting the resistance which has but little self-induction. Next the circuit is short-circuited, and finally the main circuit is broken by the lever striking the crossbar. A spring is arranged to give a quick break. 2 claims.